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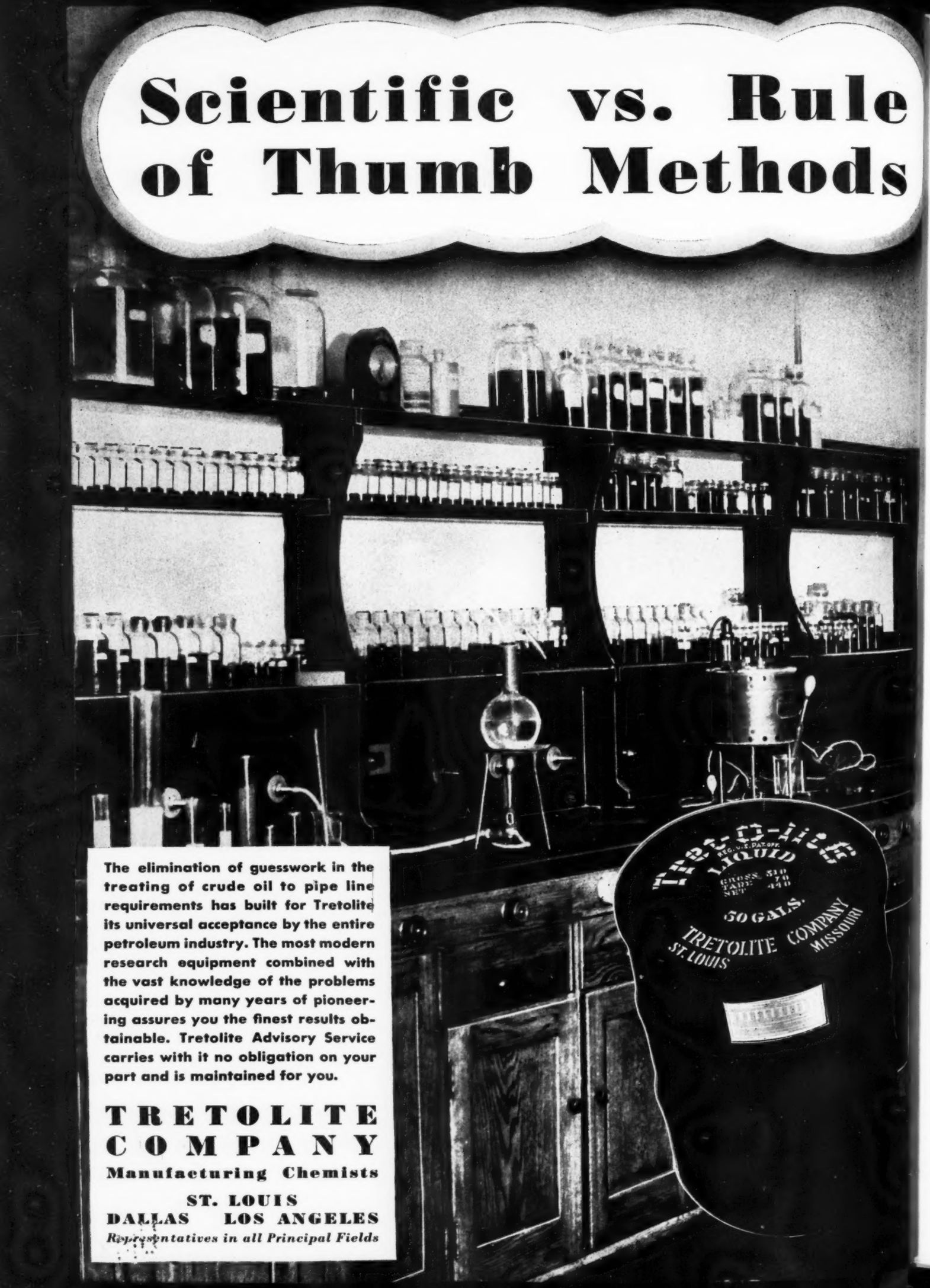
# Scientific vs. Rule of Thumb Methods

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THE Petroleum Engineer

OCTOBER 1936 VOLUME VIII NUMBER 1

A MAGAZINE OF METHODS FOR OPERATING MEN

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# Meetings

California Natural Gasoline Association—November 5, Richfield Building, Los Angeles.

•

The American Association of Petroleum Geologists, Pacific Section, annual meeting—November 5 and 6, Biltmore Hotel, Los Angeles, California.

•

American Institute of Mining and Metallurgical Engineers, Western Meeting—November 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16, Mexico City, Mexico.

•

American Petroleum Institute, 17th Annual Meeting — November 9, 10, 11, and 12, Stevens Hotel, Chicago, Illinois.

•

International Acetylene Association, 37th Annual Convention — November 18, 19, and 20, Hotel Jefferson, St. Louis, Missouri.

•

Mid-Continent Oil and Gas Association, Kansas-Oklahoma Division, Annual Membership Meeting — November 20, Tulsa, Oklahoma.

•

Independent Petroleum Association of America, Annual Meeting—November 30-December 1, Biltmore Hotel, Oklahoma City, Oklahoma.

•

Mid-Continent Oil and Gas Association, Texas Division, Annual Membership Meeting—December 4, Houston, Texas.

•

Mid-Continent Oil and Gas Association, Annual Meeting of General Board of Directors — December 15, Tulsa, Oklahoma.

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R. C. WIPPERMAN
West Coast Representative
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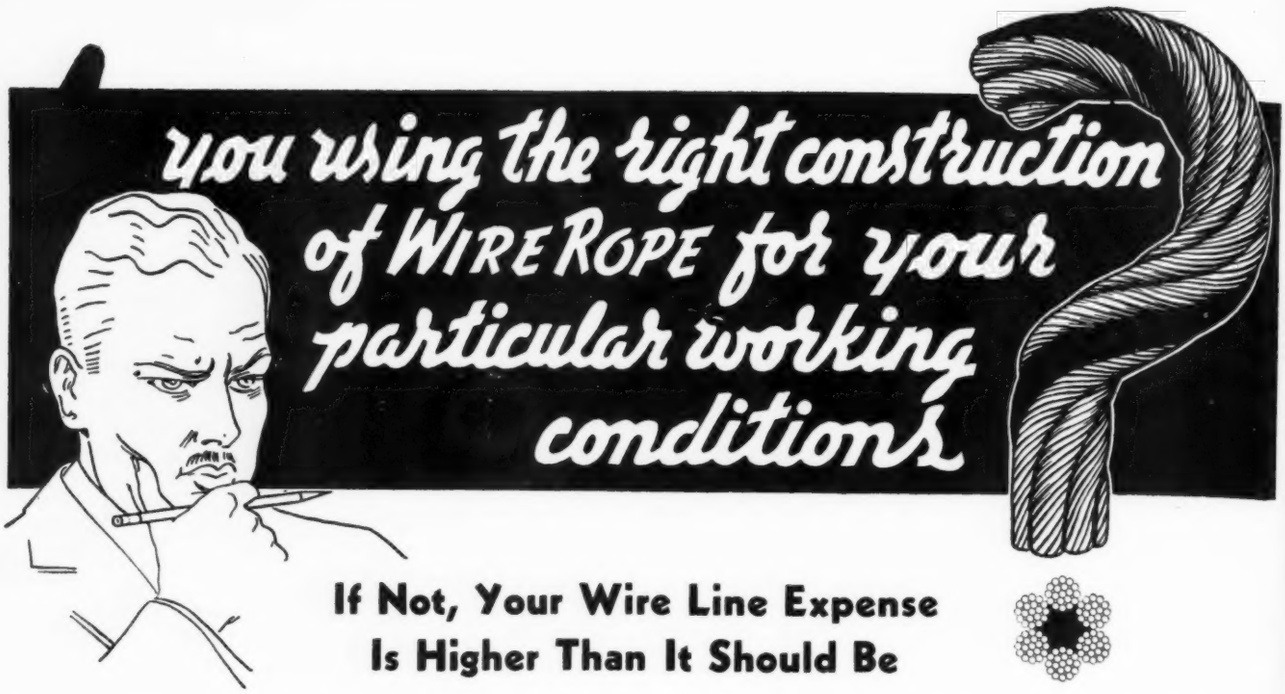


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# The Course of Oil

By K. C. SCLATER

**Rational Drilling Programs**

Within the industry the feeling is widespread that more rational drilling programs than those usually followed should be adopted in all fields under active development. Progressive oil producers have been digging into cost records and find that the total cost of producing a barrel of oil could be substantially reduced by avoiding unnecessary competitive drilling and following an economical drilling program based on sound engineering principles of field development. It is poor business to drill two wells where one might suffice, yet it would seem that under the stress of competition this practice is more prevalent than might be supposed. The folly of excessive drilling is forcibly brought home to oil producers, majors and independents alike, when each new well completed in a field reduces the allowable of every producing well in that field to the point that the margin of profit is dangerously impaired. When this point is reached agitation for increased allowables begins. Such a condition has been—and still is—primarily responsible for overproduction. Producing more oil than the market can absorb results in lower crude prices at the well, and this in turn aggravates the plight of the producer.

A rational drilling program should be based principally on a consideration of reservoir conditions. This, of course, involves the formulation of a proper well-spacing program when a new field is discovered. What constitutes a proper well-spacing program is a perplexing problem to say the least and a bone of contention even among engineers.

**Economics of Well-Spacing**

Regardless of its complexity there are a few guiding principles that might be safely observed in well-spacing problems. Ultimate economic recovery and not ultimate recovery alone is the object to be sought in producing oil. Ultimate economic recovery might be more fully defined as the greatest ultimate recovery of oil at the lowest unit production cost throughout the life of the property. It is obvious that there is a critical point beyond which the cost of recovery becomes unprofitable; to speak of ultimate recovery, therefore, without considering cost is meaningless; nevertheless, ultimate recovery is frequently mentioned and the question of cost completely ignored. Since the question of production cost is involved, the spacing program should be based on the physical characteristics of the reservoir and the amount of oil, gas, and gas energy available. This knowledge is essential in order that efficient methods of production may be put into practice. Advancements in engineering knowledge and increasing data from experience are gradually rendering an easier solution to this phase of the problem.

A producer must maintain a reasonable margin between production cost and selling price in order to make a profit; hence the question of present and future selling price must be given the greatest consideration. To neglect this factor is to admit a gross miscomprehension of the whole purpose of producing oil; for the producer to neglect it is folly and for regulatory bodies to overlook it, fallacious.

Overproduction of oil is pernicious; besides causing a reduction in selling price below the cost of production, it leads to improper and wasteful methods of utilizing petroleum and petroleum products. It results in the vicious practice of drilling more wells than necessary, increasing the cost of production; an increased cost that must eventually be borne by the consumer.

It is important for the producer to know the point at which the drilling cost begins to augment the unit cost of production, for that is the point beyond which drilling becomes excessive. These facts were clearly brought out in a paper delivered this month before one of the technical societies. Evidence was submitted indicating that drilling costs amount to almost one-half of the current cost of producing oil and virtually is the only item that readily can be reduced. Blame for close drilling in proven fields is laid to proration methods in use. A sound solution of the problem suggested is the recognition of oil in place and is the basis on which the method of proration should be determined; likewise, physical conditions in the reservoir should largely govern well-spacing.

**The Problem of Adequate Oil Reserves**

Known petroleum reserves in California are not over-abundant if one is looking very far into the future. Companies engaged in producing oil in that state are thoroughly alive to this fact and have been for a long time; but many of them are wondering where and how additional reserves are to be discovered.

As if to sound a warning note and emphasize the need for additional reserves in order to keep supply and demand in balance it has been authoritatively stated that California's oil reserves must be increased by some two billion barrels during the next five years.

There does not seem to be the least likelihood of California's petroleum producing industry being allowed to languish. Prospecting in that state now is very active. Besides the ordinary prospecting methods, geophysics is being employed on an increasingly larger scale in a diligent search for structures that might be favorable to the accumulation of oil. It is becoming more difficult to discover new reserves; they are to be found only by relentless search.

Deeper drilling often is underestimated as a key to greater potential reserves, but not in California; progress in drilling methods and the aggressiveness of the wildcatter will see to this.

# « « « HIGHLIGHTS IN OILDOM » » »

## East Texas Field Six Years Old

October 3 was the sixth birthday of the East Texas field, the world's largest oilfield. It was on that date in 1930 that C. M. "Dad" Joiner brought in his No. 3 Mrs. Daisy M. Bradford, the discovery well, and six years later the field had produced a total of 1,006,818,875 bbl. of crude oil despite drastic proration.

The total number of producing wells in the field to the end of September was 21,429, having an hourly potential production of 13,112,210 barrels. Of the total, 16,076 are classified as marginal wells and are given an allowable of 20 bbl. per day, the non-marginal wells being permitted to produce 2.32 percent of their hourly potential. These figures are according to the engineering department of the Texas Railroad Commission.

It is interesting to note that the original bottom-hole pressure of the field was 1620 pounds. At the present time it is 1183.5 pounds.

•

## Action Taken In Rodessa Gas Waste

The first definite step to curb waste of gas on the Louisiana side of the Rodessa field since the state regulatory law was passed, was taken late in September when the conservation commission made effective a 30-day temporary joint order to halt the wide-open flow of gas in that portion of the field.

The action followed recommendations that the wells in the field be held to a gas-oil ratio of 12,500 cu. ft. per bbl., or under the existing per well allowable to 3,000,000 cu. ft. of gas daily per well. Since there were objections by some operators, however, the order classified wells into two divisions, oil wells and distillate wells, and ruled that oil wells should conform to the 3,000,000 cu. ft. per day figure, while the gas-distillate wells should be permitted to produce up to 6,000,000 cu. ft. of gas daily.

Data compiled by the Rodessa Operators' Committee reveal that more than 60,000,000 cu. ft. of gas is going to waste daily in the field. The committee has recommended that "when a permanent order is issued acreage should be considered as a basis for calculating allowables." The report stated further that the field has been hurt not only by producing oil with a high gas-oil ratio, but also by high oil allowables in the densely drilled areas.

•

## Ten-Acre Spacing Rule Considered

After hearing the petition of the Skelly Oil Company for approval of a 10-acre spacing plan for the Hunton lime area of the Fitts Pool, Pontotoc County, Oklahoma, the Oklahoma Corporation Commission has taken the matter under advisement. Representatives of the petitioner, who stated that 12 companies interested in the pool are agreed upon the program, also suggested that drilling rules now in effect for the upper Simpson zone be applied to Hunton zone wells. Those angles of the petition involving the reclassification of the pool from Class D to Class C, and the establishment of a minimum allowable, will be heard October 22. There may be no effort made to push hearings on the remainder of the case until next spring, it was indicated.

## Making Survey of Stored Crude

A Nation-wide survey is being made of crude oil stocks by the U. S. Bureau of Mines, which may lead to higher state production allowables, it is announced from Washington, D. C. Seventy major companies already have received four questionnaires, and others are in the process of preparation.

A. G. White, chief examiner of the petroleum economics division of the Bureau, explains that the investigation is for the purpose of determining whether the gasoline content of several million bbl. of crude carried over from year to year has diminished to such an extent that they could be discounted in the Bureau's monthly forecast of required crude production to meet the estimated demand.

Representatives of the Interstate Oil Compact Commission have complained that these stocks were partly dead, and, therefore, the Bureau should recommnd higher monthly figures for producing states. White estimates that the task will require until next summer to complete.

•

## Oil Prospects For Alagoas, Brazil

A geophysical survey has been made of the Riacho Doce area near Maceio and submitted to the governor of Alagoas, Brazil, indicating that the district has excellent prospects for oil production. The following is a free translation of the summary of the report:

"Considering that no indication contrary to the existence of petroleum was encountered in the Riacho Doce area, and considering that the various conditions considered necessary by petroleum experts are manifest and in some cases very favorably present, it is our opinion that the state has good reasons for its hopes of petroleum in the Riacho Doce area."

Indications of the existence of petroleum in Rio Largo, some 30 kilometers to the northwest of Riacho Doce, also have been reported within recent weeks.

•

## Important Decision in Well-Drift Case

Superior Judge Palmer of Los Angeles handed down a decision recently that is of importance to those interested in drifted and intentionally whipstocked wells. The decision was given in the case of Alphonzo E. Bell Corporation vs. the Bell View Oil Syndicate. The action involved $3,500,000, that being the sum asked as damages by the plaintiff who charged that the defendant had permitted two of its wells to drift beyond its own property limits and be completed under property of the corporation.

Judge Palmer ruled in favor of the Bell View Oil Syndicate and gave as the basis for his decision the following: (1) Since the wells were drilled in 1928 and 1929 the three-year statute of limitations applies; (2) the plaintiff apparently had not been diligent in the protection of its interest in the intervening time since the wells were drilled.

Judge Palmer also stated, in making his decision, that in cases of this kind the complaining party must show not only that the wells drifted, but that the defendant's wells produced more as a result of the drift, and that the complaining party would have produced more oil had it not been for the conduct of the defendant.

# World's Deepest Commercial Well

## OLD OCEAN FIELD OF TEXAS YIELDING PRODUCTION FROM DEPTH OF 9965 FEET

By CHARLES LEYENDECKER, Staff Writer
IN THE OIL WEEKLY • September 21, 1936

HOUSTON.

ON September 11, when a well commenced yielding production from 9965 feet, Old Ocean in Brazoria County, Texas Gulf Coast, established itself as the deepest commercial oil producing field in the world. The well, Harrison & Abercrombie's Armstrong Plantation 1, came in flowing 10 to 35 barrels an hour of 55 gravity oil and a large volume of gas through varied sizes of small chokes from two sands; one at 9835-54 feet and the other at 9934-65 feet.

Since the summer of 1932, the Ventura Avenue field of California has been considered the deepest commercial producing area. It was at this time that Associated Oil Company completed Lloyd 83 at 9710 feet. There is one well in the world producing from a greater depth than any at Ventura Avenue or the one at Old Ocean, however, it is not considered of commercial value. This is Denver Producing & Refining Company's A-Dah-Noe 1, located at Binger, Caddo County, Oklahoma, which is yielding 50 barrels daily on gas-lift from below 10,000 feet.

The new world's deepest commercial well is flowing with an unusually high pressure. After washing 2½ hours, the Harrison & Abercrombie well had built up a pressure of 3200 pounds, at which time it was making 10 barrels hourly through a ¼-inch choke. Later the pressure had increased to 3325 pounds and was becoming greater. There has been no estimate made of the well's gas volume, but without doubt it is quite large. Even on a small choke, the pressure is so strong that the gas does not burn until 7 to 10 feet away from the mouth of a flare.

After washing, the well's flow was turned into a 500-pound separator, which soon required that the rapidly accumulating ice be shoveled out. In order to eliminate the present wastage of gas, the owners are rigging up 1000-pound, 500-pound and 125-pound separators, which wil be connected in series to obtain full recovery.

The 55 gravity oil being produced is different from the 67 gravity crude being

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# PROGRESS OF MAJOR PIPE LINE WORK

QUITE an extensive construction program has been announced by the Gulf Refining Company, Tulsa Pipe Line Division, for its line from Jenks, Oklahoma, station to Dublin, Indiana. Thirteen loops will be laid to the main line, a total of 287 miles, in order to increase the capacity of that portion of the system. The loops will be laid of 10-in. seamless pipe, the same diameter as the original line constructed in 1930. The program, as announced, calls for two loops in Oklahoma, five in Missouri, three in Illinois, and three in Indiana.

In addition, a 6 by 18 horizontal triplex pump will be installed at each of the 12 stations between Jenks and Dublin, giving each a total of three such units.

●

Plans, long delayed, for a pipe line between Oklahoma City and the Jesse area of Oklahoma have been partially completed. Right-of-way leases have been filed at Oklahoma City, it is stated. It is also said that, while a survey has been made for the line, no contract has been awarded for its construction.

●

Contract for the erection of four new pumping stations, and alterations and additions to six existing stations, has been let by the Shell Oil Company to Lindgren and Swinerton, Inc., of Los Angeles and San Francisco. The stations will be a part of Shell's enlarged pipe line facilities from the San Joaquin Valley oilfields to the Martinez refinery on San Francisco Bay.

The same firm has the contract for laying Shell's new pipe line between those points, which will be 304 miles in length and will cost $4,500,000. The four new pumping stations will be erected at Bakersfield, Wasco, Mid, and Kettleman. Work will start immediately.

●

The Michigan-Toledo Pipe Line Company has announced certain additions to its system that will entail the expenditure of $150,000. The line runs from Mount Pleasant to Toledo and was completed last winter. From Mount Pleasant to the tank farm of the Pure Transportation Company in Greendale Township a 6-in. line will be laid, a distance of 12 miles. A new booster station will be erected on the main line near Lansing, Michigan, and a new pumping unit is to be installed at the Crystal Township terminal.

●

Crude was moved from the Talco field of Texas through the Humble Pipe Line Company's new line for the first time early this month. The 8-in. line, which joins the company's 10-in. carrier at Longview, is 65 miles in length. Since its completion drilling activity has been stimulated in the area. It had been necessary to store considerable of the field's crude awaiting the completion of this outlet.

●

A survey is being made by the American Liberty Pipe Line Company for a 6-in. line from the Sulphur Bluff pool in Hopkins County, Texas, through the Talco field, to connect with the company's line in the East Texas field. The line will be 70 miles in length and the project includes the erection of pumping stations and tankage. The company already is constructing storage at Sulphur Bluff and Talco to handle the oil they will produce in the two fields.

Dudley S. Golding and Clint W. Murchison are the heads of the Liberty Pipe Line Company. It is rumored also that they may lay a line from the Rodessa field to East Texas to tie in with their system.

●

A contract has been let by J. F. Lucey, Ralph E. Fair, and Byrd-Frost, Inc., for the construction of a 6-in. 20-mile pipe line from the Talco field of Texas to a new refinery the group will erect at a site on the Cotton Belt Railroad.

●

The LeFlore County Gas Company of Poteau, Oklahoma, will construct a 25-mile 8-in. pipe line with terminals at Red Oak, Oklahoma, and a point approximately ten miles northeast of Poteau. Construction work will commence about October 20 under the supervision of the owners. The line will be Lindewelded.

●

To increase the capacity of its Rodessa pipe line from 18,500 to 30,000 bbl. daily, the Magnolia Pipe Line Company will install a third pumping unit at Rodessa and new stations at Dixie and Logansport. The crude is pumped to the company's refinery at Beaumont, Texas, through the 8-in. Arkansas-Beaumont carrier. Equipment at the Dixie station will consist of two electric motors driving centrifugal pumps, and at the Logansport station will be installed three reciprocating pumps driven by gas engines.

●

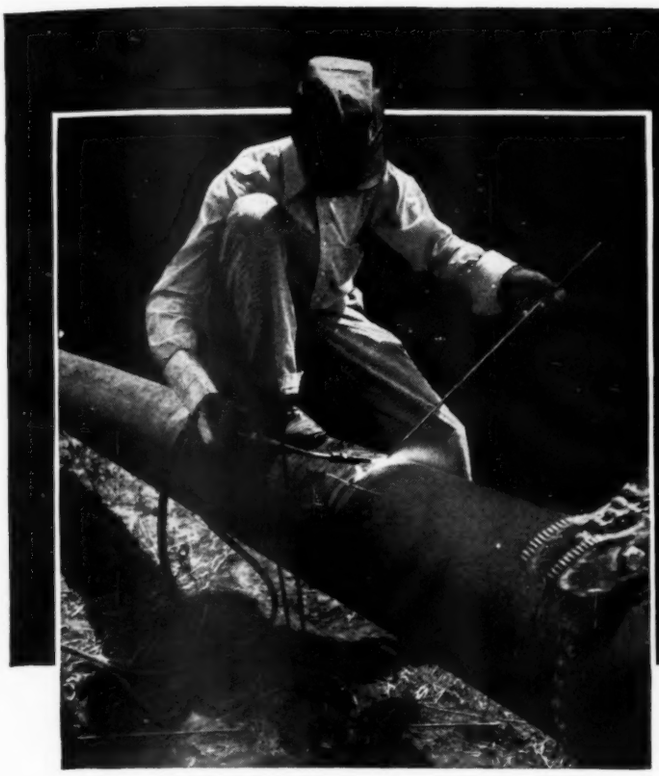
The El Paso Natural Gas Company is laying a 8⅝-in. gas line from the company's trunk line near Casa Grande, Arizona, to Ajo, a distance of 83 miles. Natural gas will be supplied to the latter point for industrial and municipal purposes. The line is being Lindewelded and when completed will be operated at 400-lb. pressure.

●

A gas line to Rochester, New York, from fields in southern New York and northern Pennsylvania, has been authorized by the State Public Service Commission. The line will be laid by the Cabot Gas Corporation. It will be of 14-in. diameter pipe and will traverse Allegany, Wyoming, Livingston, and Monroe counties.

●

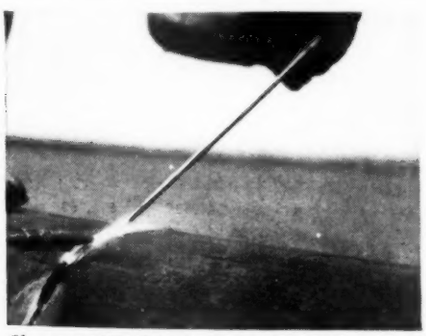
A pipe line system composed of 2-in., 3-in., 4-in., and 6-in. pipe, is being laid from wells ten miles southwest of Holcomb, Kansas, to Scott City. A total of 60 miles of pipe will be laid. Peddicord & Erard, contractors of Pampa, Texas, are constructing the line for the Tri-County Pipe Line Company.



# MULTI-FLAME LINDEWELDING *makes* DEPENDABLE WELDS

*Multi-Flame Lindewelding on the Texas Empire pipe line in Kansas.*

*Tack-welding in preparation for Multi-Flame Lindewelding.*



*Close-up of Multi-Flame Lindewelding, showing preheating flames and main flame.*

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# LATEST ACTIVITIES IN THE OILFIELDS

A SHOWING of oil in its No. 33-2 well gives the Reserve Oil Company hope of opening a new field in the Tejon area of Kern County, California. At a depth of 4474 ft. the test flowed at a rate of 25 bbl. per hour, but at 4518 ft. bottom water was encountered and it became necessary to plug back to 4474 feet. At that depth the hole was completed and a 6⅝-in. liner set; however, mechanical trouble prevented a successful completion. This difficulty will be overcome in time, and officials of the company expect a commercial producer.

●

Prospects of opening a Sundance oil pool on the Thornburg gas structure in Moffat County, northwestern Colorado, 25 miles south of Craig, are indicated by Continental Oil Company's No. 1 Henderson. Saturated cores were recovered between 2555-75 feet. At 2550 ft. 5-in. casing was set and 2-in. tubing was run preparatory to swabbing down and testing.

●

Completed at a total depth of 3315 ft., and swabbing 96 bbl. on the initial test, H. F. Patterson's No. 1 Chatterton has extended the Cut Bank field of Montana three miles to the southwest. The test also served to add approximately 5000 acres to the proved area of the field.

●

The finding of deep production on the flanks of the Jennings field of Louisiana likely will add several million bbl. of oil to the reserve, and result in a drilling campaign in that area. The Jennings field was the first to produce oil in the Louisiana Gulf Coast. On the southwest side of the field the Superior Oil Producing Company completed No. 1 Leckelt at a depth of 6380 ft. in shale. The well produced 556 bbl. per day through 11/64-in. choke on the initial test. On the scutheast flank of the field the Shell Petroleum Corporation has completed No. 1 Conover at 7530 feet.

Two new fields have been added to Southwest Texas' total within the last several days, one in Goliad County, the other in Jim Wells County. In Goliad County, No. 1 Langrebe of the California Company, a wildcat, was drilled to a depth of 5060 ft., then plugged back and completed at 4802-12 ft., flowing an estimated 125 bbl. daily. No. 1 Bennett of Tom Graham in Jim Wells County, two miles west of the Premont field, made five bbl. an hour through a small choke after being completed at a total depth of 2365 feet.

●

Northwest of Chase in Rice County, Kansas, a new pool has been opened by John Stark and the Weaver Drilling Company. No. 1 Doran, a wildcat, was brought in making 194 bbl. of oil, producing from the Arbuckle lime at a depth of 3211 feet. Another pool has been discovered in the same county, northwest of the Hauschild pool, by Sage and Douglas' No. 1. The well is drilled to a total depth of 3470 feet.

●

A new pool for Gladwin County, Michigan, appeared likely when No. 1 Crigano of Goll, Graves and Mechling, Inc., was brought in recently, swabbing 25 bbl. the first day and 20 bbl. two days later. The wildcat is four and one-half miles south of the original Beaverton pool. Production is from the Dundee lime at a total depth of 3890 feet.

●

No. 1 M. K. Graham of Helmerich and Payne, seven miles northeast of Graham in Young County, Texas, has been brought in making an estimated 250 bbl. of oil per day. The test drilled 14 ft. of sand encountered at a depth of 3617 feet.

●

Prospects for a new deep pay in the old Cement pool of Caddo County, Oklahoma, is provided by No. 10 Wade of the Ohio Oil Company and Ramsey Petroleum Company. It is on the north edge of the pool and is nearing 7000 ft. in depth. Showings of gas and oil have been obtained.

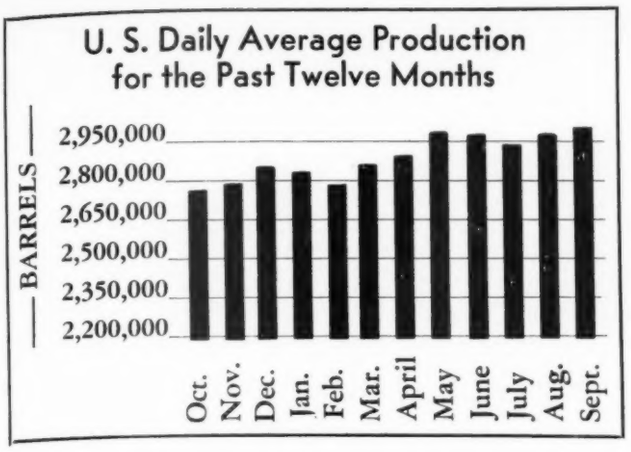
## AVERAGE CRUDE PRICES

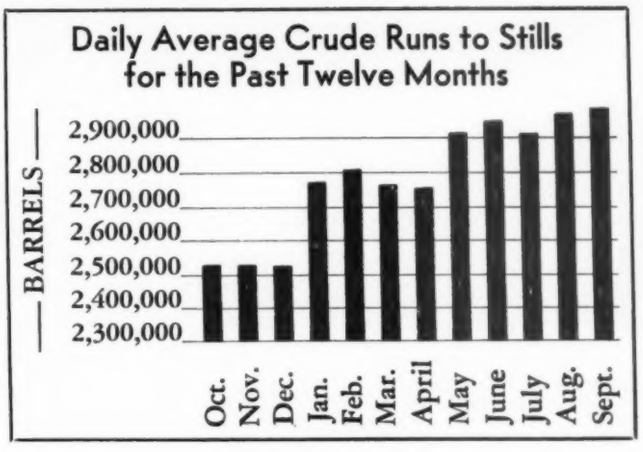
| | |
|---|---|
| California | |
| Kettleman Hills | $1.22-1.43 |
| Playa Del Rey | 1.10 |
| Coalinga | .70-.90 |
| Signal Hill | 1.10 |
| Montana | 1.35 |
| Wyoming | 1.10 |
| Colorado | 1.00-1.10 |
| New Mexico | .75-1.00 |
| Texas | |
| North Central | .84-1.08 |
| Panhandle | .81-.98 |
| West Texas | .75-.95 |
| Gulf Coast | .85-1.30 |
| Darst Creek | .88-1.22 |
| East Texas | 1.15 |
| Kansas | 1.10 |
| Oklahoma | 1.10 |
| Arkansas | .75-.80 |
| Louisiana | |
| Gulf Coast | $ .82-1.22 |
| North Louisiana | .86-1.10 |
| Illinois | 1.23 |
| Kentucky | 1.23 |
| Indiana | 1.12 |
| Ohio | |
| Lima | 1.15 |
| Michigan | .70-1.32 |
| Pennsylvania | |
| Bradford | 2.45 |
| Southwest | 2.17 |
| Eureka | 2.12 |
| Buckeye | 1.97 |
| Corning | 1.42 |
| West Virginia | 1.67 |
| Canada | 2.10-2.17 |

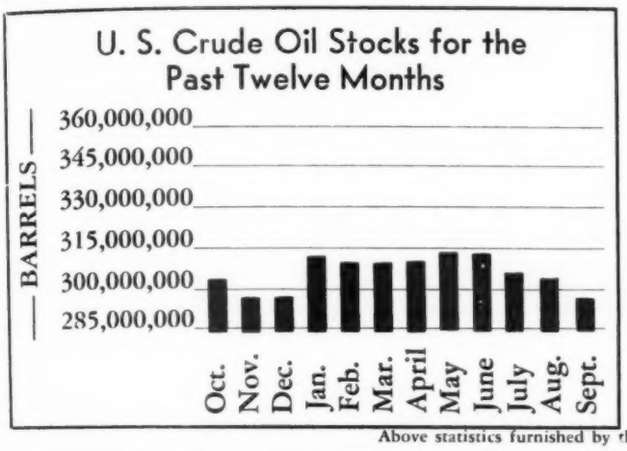
## DAILY CRUDE OIL PRODUCTION
Data Supplied by A.P.I.

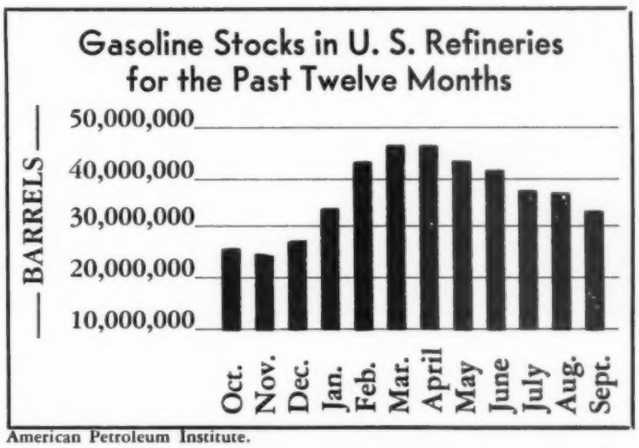
(Figures in Barrels)

| | B. of M. Dept. of Interior Calculations (September) | Week Ended Oct. 3, 1936 | Week Ended Aug. 29, 1936 | Week Ended Oct. 5, 1935 |
|---|---|---|---|---|
| Oklahoma | 563,000 | 547,500 | 572,300 | 475,450 |
| Kansas | 160,000 | 157,800 | 172,450 | 143,450 |
| Panhandle Texas | | 61,300 | 64,050 | 59,050 |
| North Texas | | 61,100 | 61,450 | 59,600 |
| West Central Texas | | 27,400 | 26,550 | 25,600 |
| West Texas | | 172,350 | 182,150 | 155,400 |
| East Central Texas | | 70,800 | 61,450 | 43,900 |
| East Texas | | 436,550 | 434,300 | 424,650 |
| Southwest Texas | | 84,350 | 87,400 | 61,300 |
| Coastal Texas | | 255,350 | 260,250 | 190,200 |
| TOTAL TEXAS | 1,123,900 | 1,169,200 | 1,177,600 | 1,019,700 |
| North Louisiana | | 78,000 | 81,200 | 27,650 |
| Coastal Louisiana | | 157,700 | 152,750 | 122,150 |
| TOTAL LOUISIANA | 186,200 | 235,700 | 233,950 | 149,800 |
| Arkansas | 30,500 | 28,200 | 29,100 | 30,200 |
| Eastern | 107,100 | 114,550 | 113,700 | 105,600 |
| Michigan | 31,300 | 29,750 | 31,250 | 53,050 |
| Wyoming | 37,200 | 41,250 | 41,550 | 41,200 |
| Montana | 13,500 | 15,750 | 18,750 | 13,050 |
| Colorado | 4,500 | 4,900 | 4,850 | 4,450 |
| New Mexico | 71,600 | 79,100 | 78,050 | 56,150 |
| TOTAL EAST OF CALIF. | 2,328,800 | 2,423,700 | 2,473,550 | 2,092,100 |
| California | 535,200 | 564,100 | 558,500 | 627,500 |
| TOTAL U. S. | 2,864,000 | 2,987,800 | 3,032,050 | 2,719,600 |




Above statistics furnished by the American Petroleum Institute.

## Summarized Operations in Active Fields for September, 1936

| Fields | Completions | Producers | Locations | Drilling Wells | Depth of Production | No. Casing Strings | Gravity of Oil | Type of Tool Used |
|---|---|---|---|---|---|---|---|---|
| TEXAS | | | | | | | | |
| East Texas | 139 | 132 | 40 | 110 | 3500-3700 | 2 | 40 | Rotary |
| Duval County | 97 | 86 | 24 | 45 | 1554-2900 | 2 | 22 | Rotary |
| Archer County | 30 | 12 | 8 | 19 | 660-1800 | 1 or 2 | 40 | Rot.-Cab. |
| Panhandle | 64 | 62 | 39 | 146 | 1700-3900 | 2 | 40 | Rotary |
| Refugio County | 14 | 12 | 3 | 9 | 4900-5900 | 2 | 38 | Rotary |
| Nueces County | 74 | 67 | 10 | 49 | 3922-5878 | 2 or 3 | 21-54 | Rotary |
| San Patricio County | 22 | 18 | 3 | 11 | 3987-6141 | 2 | 23-65 | Rotary |
| Sam Fordyce | 8 | 6 | 2 | 6 | 2833-3200 | 2 | 21.5 | Rotary |
| Talco | 30 | 29 | 19 | 31 | 4230-4361 | 2 | 16-24 | Rotary |
| OKLAHOMA | | | | | | | | |
| Oklahoma City | 21 | 19 | 5 | 14 | 6450-6682 | 3 | 39 | Rotary |
| Fitts Field | 42 | 35 | 13 | 49 | 1800-4488 | 2 or 3 | 38 | Rotary |
| Osage County | 34 | 27 | 6 | 30 | 380-2850 | 2 | 37.5-40 | Rot.-Cab. |
| KANSAS | | | | | | | | |
| McPherson County | 9 | 5 | 4 | 18 | 2900-4300 | 2 | 38 | Rot.-Cab. |
| Russell County | 29 | 25 | 8 | 34 | 2926-3435 | 2 and 5 | 32-37 | Rot.-Cab. |
| Rice County | 35 | 28 | 8 | 30 | 3222-4085 | 2 and 5 | 42-48 | Rot.-Cab. |
| Reno County | 23 | 17 | 3 | 27 | 3300-4375 | 2 and 5 | 42-48 | Rot.-Cab. |
| LOUISIANA-TEXAS | | | | | | | | |
| Rodessa | 45 | 44 | 9 | 64 | 5950-6450 | 3 | 39 | Rotary |
| CALIFORNIA | | | | | | | | |
| Kettleman Hills | 6 | 6 | 2 | 17 | 8300-8730 | 3 or 4 | 40 | Rotary |
| Midway-Sunset | 13 | 12 | 13 | 22 | 1400-3100 | 1 and 2 | 11-30 | Rot.-Cab. |
| Mountain View | 5 | 5 | 6 | 12 | 5200-6000 | 2 | 20-40 | Rotary |
| Montebello | 4 | 4 | 5 | 15 | 5000 | 2 | 36 | Rotary |
| Round Mountain | 5 | 5 | 6 | 7 | 1600-2400 | 1 | 16-18 | Rotary |
| Kern | 3 | 2 | 9 | 8 | 1000-1200 | 1 | 12-15 | Rotary |

## Field Activities by States for September, 1936

| State | Completions | | Producers | | Locations | | Rigs | | Drilling Wells | | Production, 1935 (In Barrels) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | September | August | September | August | September | August | September | August | September | August | |
| Arkansas | 6 | 13 | 2 | 1 | 7 | 10 | 6 | 7 | 30 | 32 | 11,140,750 |
| California | 92 | 65 | 82 | 55 | 94 | 113 | 107 | 104 | 252 | 281 | 207,899,480 |
| Colorado | 2 | 2 | 1 | .... | .... | .... | 5 | 4 | 31 | 34 | 1,565,150 |
| Illinois | 9 | 10 | 4 | 6 | .... | .... | 27 | 24 | 16 | 18 | 4,352,000 |
| Indiana | 7 | 10 | 4 | 6 | .... | .... | 4 | 3 | 28 | 27 | 762,000 |
| Kansas | 190 | 141 | 146 | 100 | 114 | 189 | 45 | 49 | 325 | 338 | 53,013,450 |
| Kentucky | 28 | 33 | 25 | 26 | .... | .... | 6 | 5 | 22 | 18 | 4,860,000 |
| Louisiana | 124 | 85 | 104 | 70 | 98 | 102 | 40 | 45 | 173 | 187 | 50,299,950 |
| Michigan | 81 | 65 | 54 | 42 | 45 | 78 | 70 | 67 | 121 | 131 | 15,661,350 |
| Mississippi | .... | .... | .... | .... | .... | .... | 4 | 3 | 8 | 9 | Gas. Prod |
| Montana | 33 | 16 | 27 | 13 | .... | .... | 7 | 10 | 62 | 64 | 4,304,100 |
| New Mexico | 57 | 50 | 54 | 48 | .... | .... | 18 | 20 | 104 | 108 | 19,195,500 |
| New York | .... | .... | .... | .... | .... | .... | 3 | 1 | 5 | 6 | 3,191,900 |
| Ohio | 170 | 148 | 115 | 141 | .... | .... | 52 | 64 | 190 | 203 | 4,234,000 |
| Oklahoma | 276 | 252 | 207 | 197 | 192 | 266 | 79 | 70 | 506 | 548 | 181,152,050 |
| Pennsylvania | .... | .... | .... | .... | .... | .... | 25 | 18 | 127 | 132 | 14,478,000 |
| Texas | 1192 | 1027 | 931 | 820 | 1240 | 1632 | 578 | 620 | 1714 | 1812 | 377,747,205 |
| West Virginia | 37 | 64 | 31 | 52 | .... | .... | 45 | 30 | 168 | 149 | 3,818,400 |
| Wyoming | 12 | 13 | 9 | 9 | .... | .... | 6 | 7 | 59 | 63 | 13,390,100 |
| Totals | 2316 | 1984 | 1796 | 1580 | 1790 | 2390 | 1127 | 1147 | 3941 | 4160 | 970,995,335 |

# THE MONTH'S ACTIVITIES IN REFINING

## Percent Refinery Capacity Operated

**Western Division, 70.1 Percent** **Central Division, 72.7 Percent** **Eastern Division, 84 Percent**

A REFINERY of 3500-bbl. capacity, and estimated to cost approximately $300,000, will be erected in the Talco field of Texas, it has been announced. Interested in the project are J. F. Lucey, Ralph E. Fair, D. Harold Byrd, and Jack Frost, all of Dallas. The latest type cracking equipment will be installed.

●

A new refinery and terminal is being constructed on the Corpus Christi, Texas, ship channel. The project is an extensive one costing approximately $1,000,000. The refinery will have a daily capacity of 6000 bbl., and will be a combination cracking and skimming unit. The terminal will have a capacity of 50,000 barrels. Owners of the refinery and terminal are the Petrol Coastal Refining Company headed by Peter P. Prunty and associates of New York City.

●

The Shell Petroleum Corporation is installing a steam-generating plant at its Houston, Texas, refinery. Two steam generators, each generating 140,000 lb. of steam per hour at 500 lb. pressure, have been ordered. The units will be installed in the open, without covering, an innovation in boiler house practice. The Henry Vogt Company is making the installation on a turnkey basis.

●

The Terminal Refining Company is constructing a 2500-bbl. skimming plant at Corpus Christi, Texas. It is on a site west of the city near the ship channel. A terminal will be constructed at the refinery for the storing of crude oil and refined products. Heading the company are T. C. McArdle of Chicago and A. R. Matthews of Fort Worth, Texas.

●

The Tide Water Oil Company will install a propane-butane rectification plant at its Bayonne, New Jersey, refinery. It is announced by officials of the company that the plant will have a capacity for producing 45,000 gal. of propane daily and 7500 gal. of butane.

●

Ypiranga, S. A., Companhia Brasilera de Petroleo is the name of a firm recently organized by Brazilian and Uruguayan capital to refine and distribute petroleum products in the vicinity of Rio Grande, Brazil. Crude will be obtained from Peruvian fields and other fields along the western coast of South America.

●

A gasoline plant for blending natural gasoline with crude oil is being erected at Corpus Christi, Texas, by Hanlon-Buchanan, Inc., of Tulsa, Oklahoma, that will cost approximately $100,000.

●

The Arkansas-Louisiana Gas Company expects to have its natural gasoline plant, now under construction in the Sligo gas field of Bossier Parish, in operation by the first of 1937. It will be of the absorption type and will have a daily capacity of 15,000,000 cu. ft. of gas, manufacturing approximately 6,000 gal. of gasoline per day.

●

The Ecco Oil Corporation has been formed for the purpose of erecting a blending and absorption gasoline plant in the Sibley field of Webster Parish, Louisiana. The organizers are a group of Shreveport men headed by J. P. Evans as president. Other officers of the company are Jack Coast, vice-president, and H. R. Scivally, secretary-treasurer, the officers and W. J. Hobby forming the board of directors.

●

Leonard Refineries, Inc., of Alma, Michigan are adding a new Dubbs cracking unit to their refinery. The unit will have a capacity of 1200 bbl. daily and will be completed about January 1.

●

The Magnolia Petroleum Company and the Phillips Petroleum Company, as a joint proposition, will construct a natural gasoline plant and carbon black plant in Moore County, Texas. The Magnolia will erect a gasoline plant of 30,000,000-cu. ft. daily capacity, and Phillips will construct a carbon black plant to utilize the residue gas from the gasoline plant.

**Crude Runs to Stills, Gasoline and Gas Fuel Oil Stocks**
**Week Ended October 3, 1936**
**A.P.I. Figures**
(Figures in Barrels of 42 Gallons Each)

| DISTRICT | Percent Potential Capacity Reporting | Daily Avg. Crude Runs to Stills | Percent Operated of Total Capacity Reporting | Total Motor Fuel Stocks Thousands of Bbl. | Gas and Fuel Oil Stocks Thousands of Bbl. |
|---|---|---|---|---|---|
| East Coast | 100.0 | 513,000 | 83.8 | 16,130 | 12,463 |
| Appalachian | 94.8 | 103,000 | 70.5 | 2,041 | 627 |
| Ind., Ill., Ky | 96.1 | 434,000 | 97.7 | 8,184 | 6,445 |
| Okla., Kans., Mo. | 84.8 | 278,000 | 72.4 | 5,542 | 3,541 |
| Inland Texas | 48.5 | 117,000 | 73.1 | 1,384 | 1,718 |
| Texas Gulf | 97.0 | 622,000 | 87.6 | 6,924 | 8,646 |
| La. Gulf | 96.4 | 115,000 | 70.6 | 1,555 | 2,369 |
| No. La.-Ark | 90.0 | 43,000 | 59.7 | 277 | 359 |
| Rocky Mt. | 61.9 | 45,000 | 75.0 | 759 | 772 |
| California | 92.6 | 515,000 | 65.3 | 11,736 | 73,462 |
| Reported | 89.8 | 2,785,000 | 78.7 | 54,532 | 110,402 |
| Est'd Unreported | | 215,000 | | 3,078 | 2,310 |
| *EST'D TOTAL U.S. Oct. 3, '36 | | 3,000,000 | | 57,610 | 112,712 |
| *EST'D TOTAL U.S. Sept. 26, '36 | | 2,990,000 | | 56,472 | 112,504 |
| U. S. B. of M. *Oct. 3, '35 | | **2,746,000 | | 51,185 | 110,123 |

*Estimated Bureau of Mines basis.
**October, 1935, daily average.

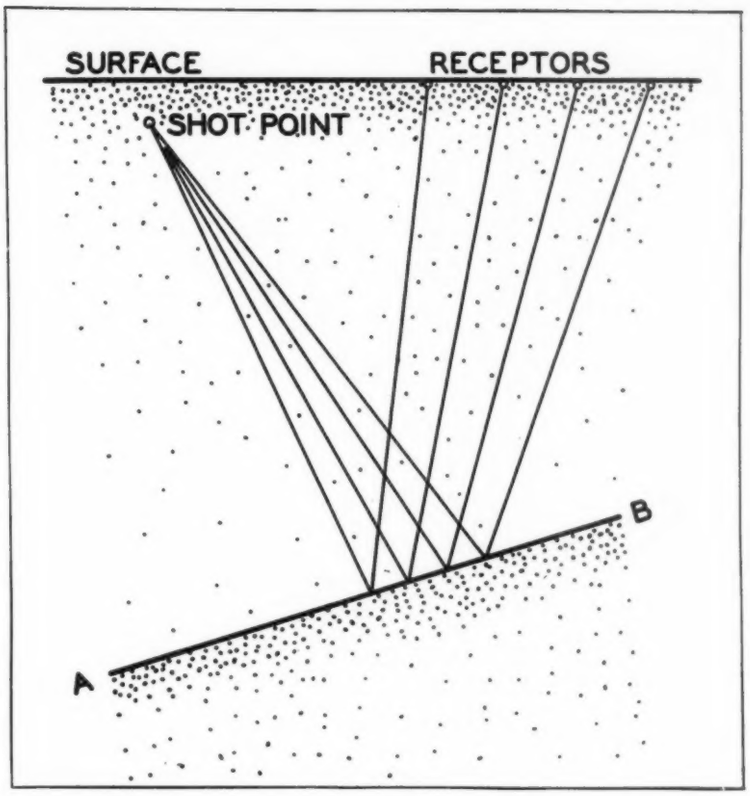



Fig. 1—A simple case of waves reflected from stratum A-B and returning to four receptors. If the times required for the waves to reach any two receptors are accurately determined and the velocity of propagation is known, the position of the stratum A-B may be accurately located.

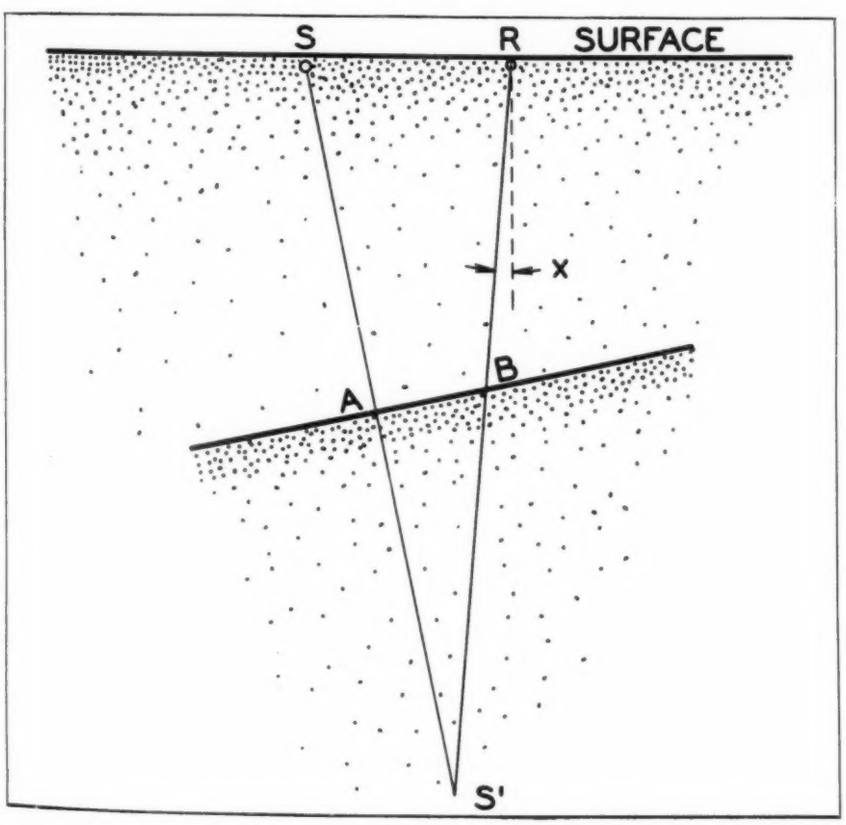
By
WALLACE A. SAWDON
Petroleum Engineer, Los Angeles

●

Elastic Wave Exploration Involves a New Reflection System with Controlled Directional Sensitivity

●

# New Geophysical Method Provides Reliable Data for Structure Mapping

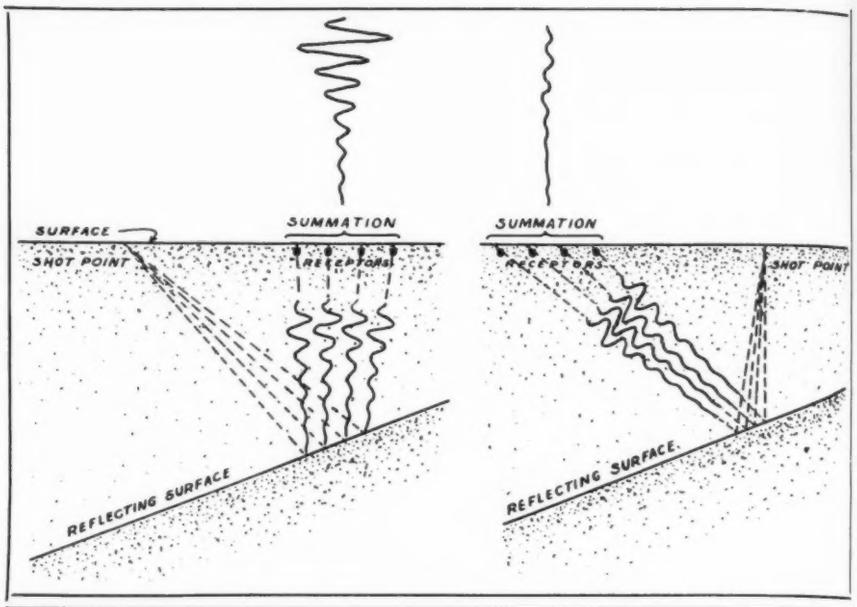



ALTHOUGH there is no need for immediate increased oil production in the United States, the fact remains that new fields must be discovered if this country is to maintain its present supply of crude. Estimates place our known reserves at from ten to thirteen billion barrels; but with a production of a billion barrels a year this does not mean that we are assured of a yearly production of that amount for the next ten or thirteen years. New areas must be found for the mere maintenance of such production; and it is generally conceded that geophysical prospecting will play an ever-increasing part in the discovery of those needed areas.

The various geophysical methods that have been developed all have been more or less successful in locating pos-

Fig. 2—This illustrates a simple but sufficiently accurate method for locating stratum A-B when the apparent angle of arrival and the total travel distance are known. S represents the shot and R the point in the receptor group to which the total travel distance is referred. The total travel distance RS' is laid out at the proper angle of arrival "X" and A-B, the perpendicular bi-sector of S-S' is drawn.

Fig. 3 (Right)—Showing the effect on the summation of records by the angle at which the wave-trains reach the surface.



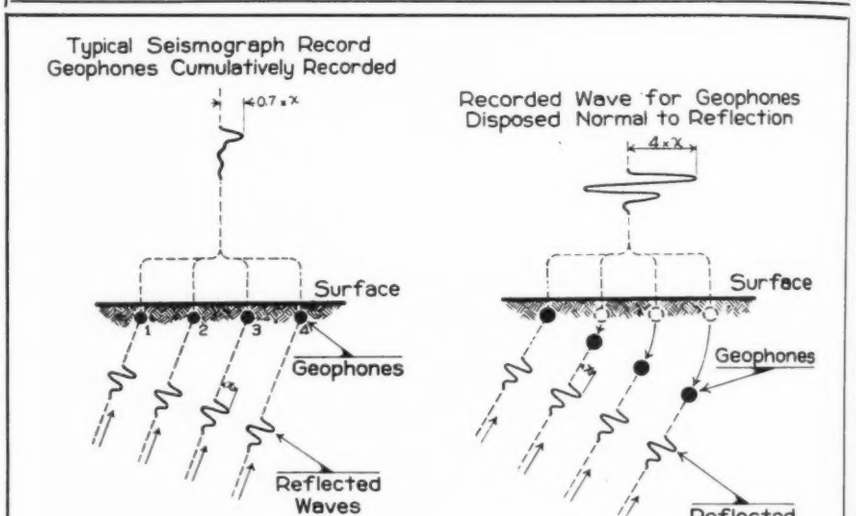




Fig. 4 (Right)—The distorted and weakened summation record caused by wave-trains reaching the individual geophones at different times when the waves return to the surface at an angle is shown on the left. On the right is a theoretical arrangement of the geophones to rectify this condition and give a true summation of the wave-trains.

sible oil-bearing structures. During the past few years, however, the seismograph probably has been most widely used; yet the seismic method as generally applied frequently will supply data that are too confusing for close interpretation. It is for this reason that a new method that segregates the reflected waves and permits their proper identification was developed by the Rieber Laboratory in Los Angeles, California. It has been named the Rieber Geo-Sonograph method.

As in the ordinary seismograph procedure, this new method utilizes the discharge of a shot at one point and picks up the reflected waves at other points at known distances from the shot. Including the manner of recording the wave impulses, the method differs radically from that point on in accumulation, presentation, and interpretation of data.

All seismograph methods of determining subsurface geology are based on the assumption that elastic waves set up by an explosion near the earth's surface are reflected from subsurface strata and return to receiving stations near the shot. At these receiving stations are placed geophones that record the wave-train. The relative time of arrival of a wave-train at different receptors determines its apparent angle of arrival from the earth and the total time of travel determines its total distance traveled in the earth. The object of all seismograph methods therefore is the accurate determination of the times of arrival of reflected wave trains at several receiving stations. A simple condition is shown in Figs. 1 and 2.

A number of seismograph methods record the wave-train by means of an oscillograph, which presents a summation of the impulses picked up by a number of geophones at the receiving station. When the reflected waves reach the geophones in a direction normal to the surface, this summation gives a clear record, as shown to the left in Fig. 3. When the waves reach the surface at an angle, however, the summation may be even less definable than for any one geophone as the drawing on the right of Fig. 3 clearly indicates. This condition might be corrected by placing the geophone in the earth on a line normal to the direction of the wave, as shown in Fig. 4. Obviously, however, this is impossible; moreover, the geophysical operation would be unnecessary were the angle known in advance.

With the new reflection system this obstacle is overcome by the method of recording and the means provided for transferring the field record into a visual record for use. Ten receptors are arranged in an appropriate pattern on

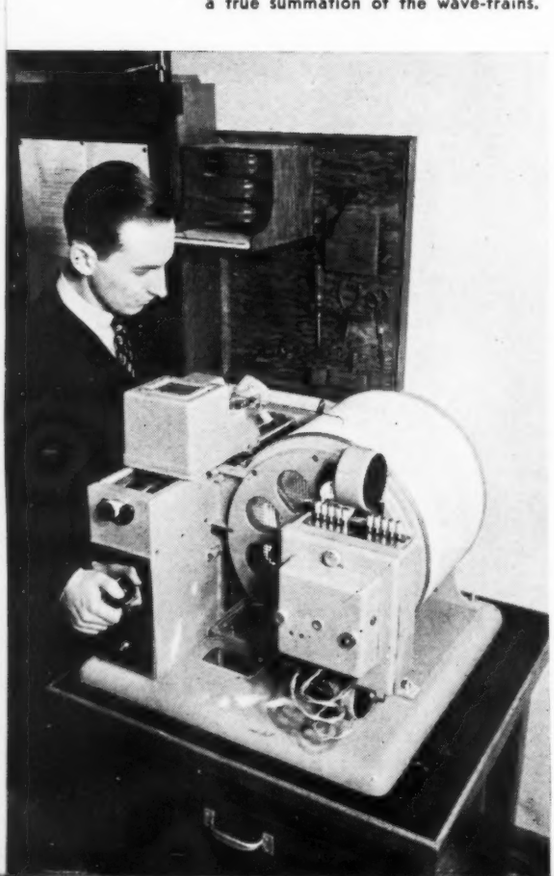


Fig. 5 (Left)—The sound track film is placed in this analyser, which automatically records from the film summation traces of wave-trains for successive angles of reception. These traces can be seen being made on the large revolving drum by the transcribing pen. The film itself and the visual record made from it are shown in Fig. 9.

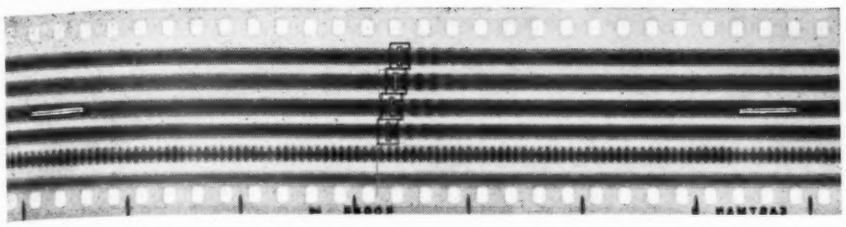


Fig. 6 (Left)—By adjusting the apertures in the analyser as here indicated, the wave-trains can be put in phase and the same result obtained as shown to the right in Fig. 4.

Fig. 8 (Below)—Showing the effect of a fault where diffracted and reflected waves may reach the receptors at equal times.

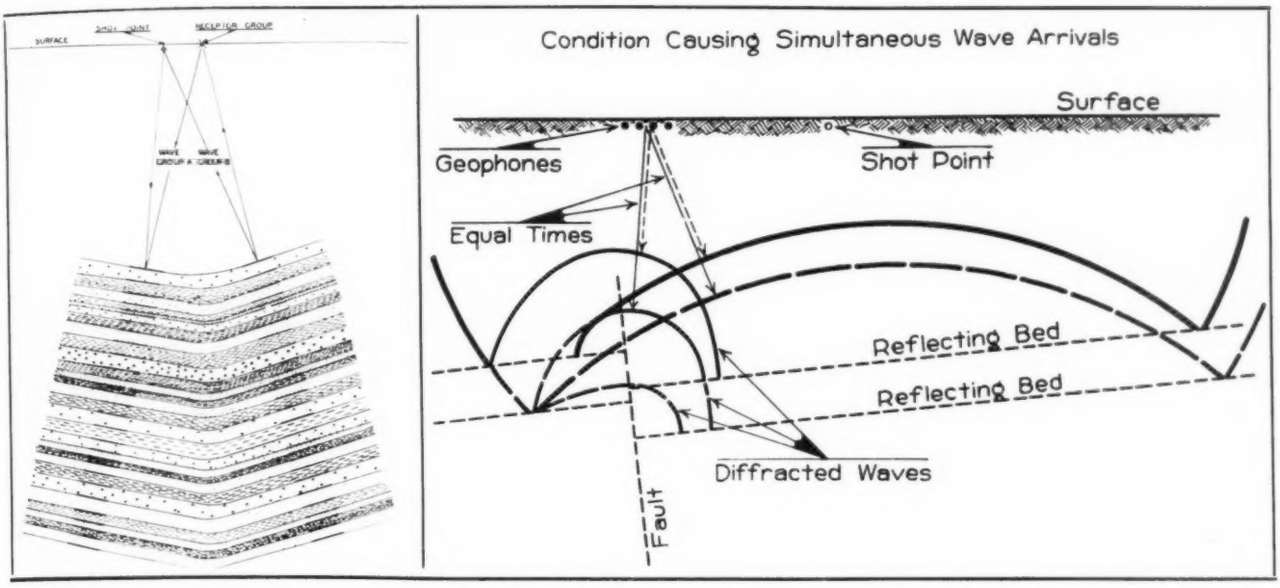



Fig. 7—Even a simple syncline returns waves to the receptors from more than one direction at the same time.

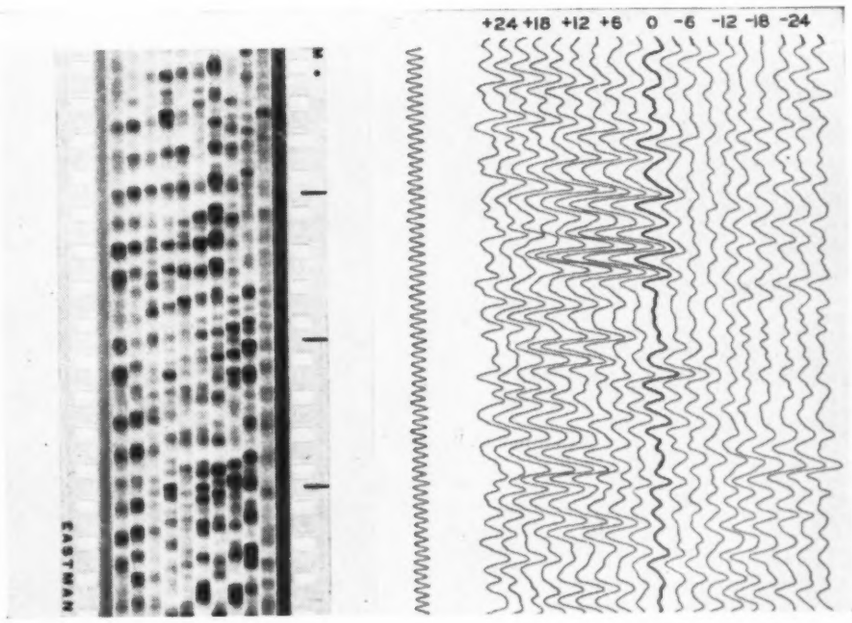
the earth's surface and the wave impulses picked up by all ten receptors are photographed on a strip of 35-mm. film in the form of ten sound tracks. Though this variable density record on the film may be inspected visually, it is especially adapted to electro-optical analysis and therefore is run through a specially designed apparatus that sums up the wave impulses and records them in a clearly defined line. By means of this analyser, the difference in time of arrival at successive receptors and the total travel time to any point in the receptor group may be found mechanically from the variable density record without the intervention of human observational errors.

The automatic optical analyser is shown in Fig. 5. The strip of film with the ten variable density tracks is run before ten apertures and the variable density tracks are reproduced as varying electrical currents. These currents then actuate a pen arm that transcribes the summation of the wave-trains onto a strip of paper, which is revolved on a drum under the pen in synchronism with the film as it passes before the apertures. Controlled direction selection also is provided in the analyser, as will be described later.

Each of the ten variable density tracks on the film may be reproduced as a varying electrical current in a manner similar to that employed in reproducing sound in the theater. The time at which any part of the wave is reproduced depends upon the position along the film at which reproduction takes place. In running the film through the analyser, an aperture is provided for each variable density track and by varying the position of these apertures as shown in Fig. 6, the reproduced electrical waves may be placed in any desired phase difference. Thus the sum of the waves on all the tracks in any phase relation may be obtained by properly moving the points of repro-

Fig. 9—Geo-sonograph variable density film record.

Geo-Sonograph cumulative analysis record. Angle of arrival in earth.



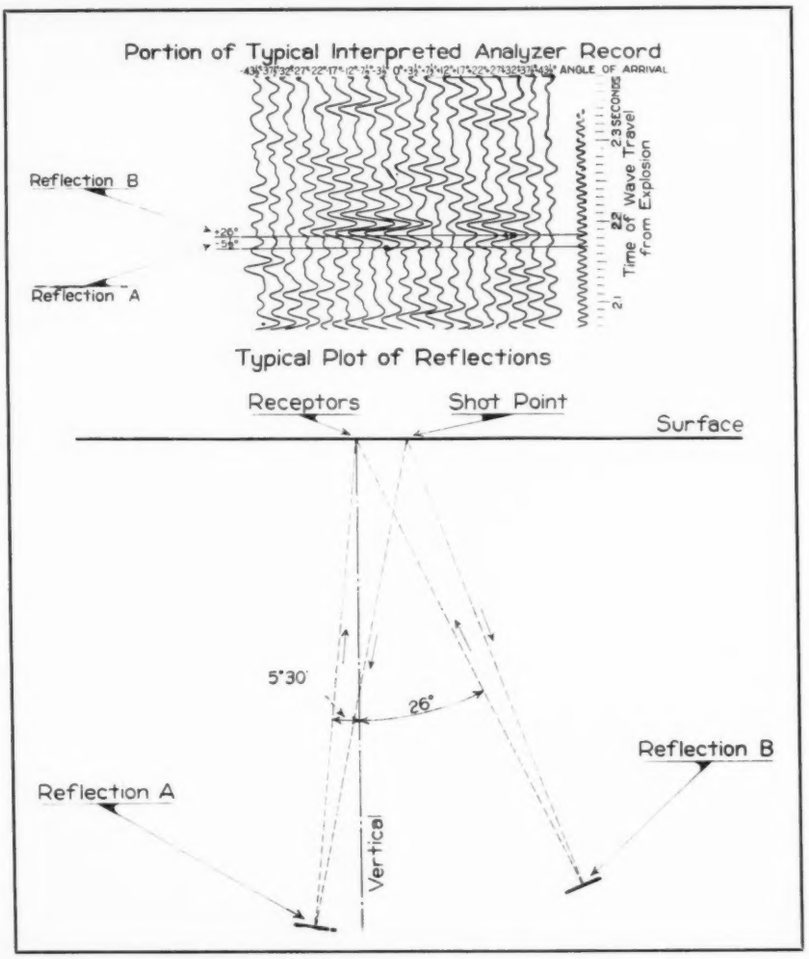



**Fig. 10—The method of interpreting the analyser strip is here indicated.**

and sometimes in the identification of waves that are of less importance than some of the lost waves. The effect of the simultaneous arrival of a group of waves from different directions naturally is difficult to analyze visually.

This condition of a number of waves traveling in the same medium at the same time can be compared to carrier waves in the ether. A radio set without tuning would receive from the ether so many interlocking sounds that the ear would be unable to identify any of them separately. Analogous to tuning out unwanted waves on the radio is the manner in which definite wave-trains can be isolated by the analyser. The radio waves in the ether have different, tunable vibratory frequencies by which one may be selected. Wave groups returning from the earth as reflections from an explosion, however, do not differ materially in frequency; but they do differ in direction.

A directionally sensitive receiving means therefore was incorporated in the analyser. The trace of the summation of the wave impulses recorded as variable densities on the film is made on the analyser strip for one direction in space. After this is completed, the analyser automatically sets itself for a

duction of each track and adding the electrical waves with the phase relation so introduced. By so placing the apertures in echelon as shown in Fig. 6, the same result is obtained as shown to the right in Fig. 4.

One simple wave-train reflected by a stratum is seldom found in actual practice, however. As illustrative of what happens when waves arrive from more than one direction, a simple syncline as shown in Fig. 7 will suffice. With this illustration in mind, the geologist and petroleum engineer undoubtedly will think of a great number of other subsurface conditions from which this same confusing multiplicity of directions would be imparted to returning waves. Then there may be diffracted waves as well as reflected waves as in the case of a fault as illustrated in Fig. 8. In regions of sharp folding or of general unconformity the reflections will arrive from many directions, the time of arrival often being simultaneous. This results in the masking of many waves that are important

**Top photo—The shot**

**Below—Recording truck showing the cable reels arranged on the side with a folding cover to protect them**

similar trace at another angle. For a satisfactory average working result, about 40 trips through the analyser are necessary for each record unless previous records show that it is unnecessary. A typical analyser strip together with the film from which it was reproduced is shown in Fig. 9.

The interpretation of the records made is done by a trained force with highly perfected equipment. In Fig. 10 is shown a short section of an analyser record on which have been marked two reflections arriving almost simultaneously but from different angular directions. Below the record is a diagram showing the reconstructed section of structure in which the sources of these two reflections have been plotted. The data from which geological conclusions are based and from which structural maps are compiled are furnished in both cross-section and plan.

### Field Operations

The field crew used in this new method of geophysical exploration is about equivalent in numbers to that used in other reflection work. The drilling requirements also are about the same except that shallower shot holes may be used with the new method. The speed of operation in the field probably is a little greater than that obtainable with the other reflection methods.

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A water-flood power plant in Pennsylvania operated by the Niagara Oil Company and equipped with submerged coils in the flood-pump supply tank so that water can also be utilized for engine-cooling

●

# Cooling Engine Jackets With Water-Flood Water

## Dual Use of Water Is Economical Practice in Bradford Field

WATER ordinarily used in the Bradford Field for flooding the sand in secondary producing methods is always cool, so that any increase in temperature does not affect its value for this purpose. Niagara Oil Company has taken advantage of this situation by utilizing the low temperature of the flooding water to cool the water used in engine jackets. This was done by laying a series of coils in the flood pump suction supply tank so that a closed system was established for the jacket water.

Treated water is used for flooding the sand, and exceptional care is exercised at all times to prevent contamination of it by foreign matter, pipe scale, or other impurities that might in time cause a film to form on the face of the sand at the bottom of the well. Using this water direct in the jackets of the Diesels would not be detrimental were it not for the fact that some of the metal from the cylinders might find its way into the well in the form of oxide.

The coils used for cooling the the jacket water are placed in the pump supply tank in such a manner that adequate circulation can be obtained by the water as it flows into the tank and is removed from the suction line at the base. The closed system is kept filled by the addition of the necessary amount of water, which is drawn from the supply tank to make up any deficiency. A circulating pump is used for each engine, which is driven from a belt in the usual manner where this type of pump is employed.

A sufficient volume of water is handled by the flood pumps to insure adequate temperatures on the closed system of jacket cooling water, without raising the temperature of the flood water appreciably. By using this system, the cost of construction has been kept down, where otherwise a separate tank with a louvre tower would need to be used for cooling.

Exterior view of engine room, Rodessa Compressor Station of United Gas Public Service Company

# Two-Stage Compressor Station Completed at Rodessa

## New Plant of United Gas Public Service Company is Among Largest of its Type in the United States — Capable of Handling 60,000,000 cu. ft. of Gas Daily

By
FRANK H. LOVE

ONE of the largest and most modern compressor stations in the South, and among the largest of the 2-stage plants in the United States, is being completed in the Rodessa field of Louisiana by the United Gas Public Service Company. Identified as the Rodessa Compressor Station, and capable of handling 60,000,000 cu. ft. of gas daily, the plant will, after compressing the gas to 450-lb. pressure, boost it to the Myrtis gasoline plant of the same company where it will be processed and the residue sold commercially. The latter plant is being enlarged to handle a greatly increased volume, and with these two projects placed in operation considerable gas now being wasted in the Rodessa field will be utilized.

In constructing the Rodessa compressor station officials of the company have been motivated by a desire to erect a plant up-to-date and efficient in every respect, and their purpose has been admirably attained. The main compressor units, auxiliary equipment, the piping layout, housing facilities for the operating crew, etc., all conform to the latest design and practice.

The engine room houses eight 1000-hp., horizontal, double-acting, twin-tandem engines direct-connected to 2-stage compressors. Low-stage compressor cylinders are 20½ in. by 36 in. and the high-stage cylinders are 12½ in. by 36 inches. The latter were designed for a working pressure of 500 lb. and the former for a working pressure of 175 pounds. All units are securely bolted to heavy concrete foundations. Provision has been made for the installation when needed of four additional units of the same size.

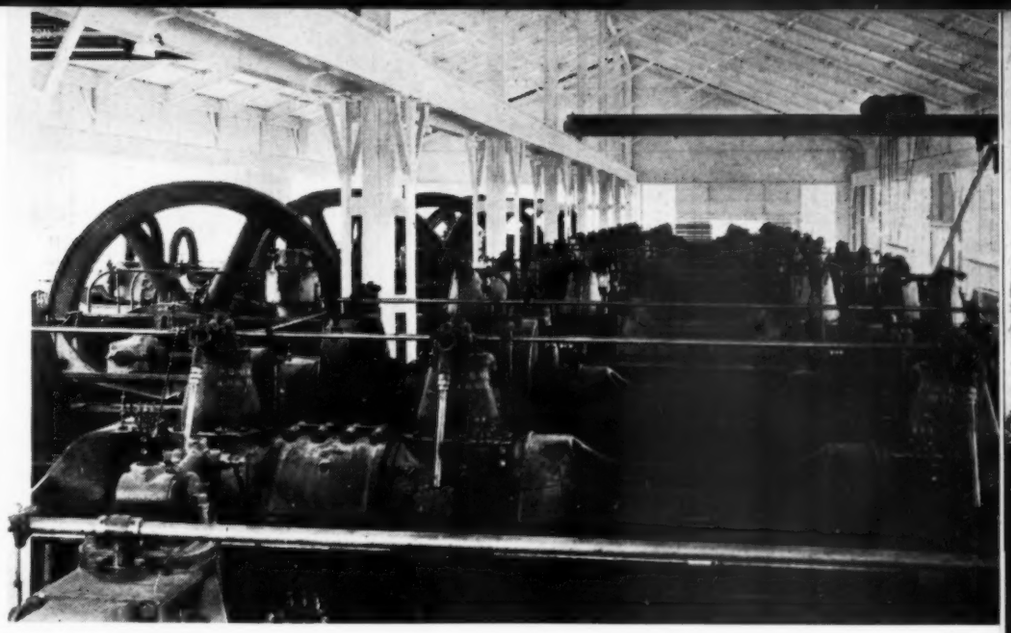
Each engine is equipped with an efficient system of lubrication. It is of the forced-feed type with the oil pump operated off the engine. All oil is centrifuged and used until its lubricating properties are exhausted. For this purpose a centrifuge and oil pump are housed in a steel-covered building in close proximity to the engine room. When the oil has been reclaimed it is pumped back into the lubricating system of the plant. A 10-ft. by 30-ft. horizontal lube oil tank is situated between the centrifuge building and incoming scrubber, used for the storage of fresh oil.

Engine jacket water is cooled by being circulated from the engines to a concrete hot well, 20 ft. by 20 ft. by 10 ft., from where it is pumped over the cooling tower and to the cold well (of the same dimensions as the hot well) situated at one end of the tower. From this well it is picked up by a suction pump and discharged to the engines to complete the cycle.

The cooling tower is of the enclosed type, measuring 175 ft. in length and 52 ft. in height. At its base, but on the outside, are four interstage gas scrubbers, the two used on intermediate-stage compression being five ft. in diameter by 25 ft. high, and the two employed on high-stage compression three ft. in diameter by 20 ft. in height. Within the base of the cooling tower are 18 open-type 2-pass gas coolers.

Adequate auxiliary equipment, such as generators, water circulation pumps, etc., are provided, being housed in a building of steel construction 81 ft. by 31 ft. by 20 feet. In this structure are two 250-hp. vertical compressors and to each engine is direct-connected a 175-kw. generator that supplies power for the operation of the plant, including lighting of the cottages, station buildings and grounds, for motors driving pumps and the oil centrifuge, and for the ignition on engines. In the auxiliary building also are four centrifugal pumps for water circulation, driven by 60-hp. motors and each having a capacity of 1500 gal. per minute. In addition there are two air compressors to supply starting air for the engines, providing 250-lb. air pressure for this purpose.

The flow of gas through the plant follows a course that is conventional in most respects. All gas is metered at the wells, being taken off the separators and received at the station at 50-lb. pressure. It is then boosted through two stages of compression to a discharge pressure of 450 pounds. On the low stage of compression, suction and discharge headers are 24 in., while on the high stage the suction header is 24 in. and discharge header 18 inches. The station discharge to the Myrtis gasoline plant is through a 16-in. line. The low-stage suction header is looped to allow for the intake of a maximum volume of gas. Gas from the Louisiana and



Gas is received at 50-lb. and discharged at 450-lb. pressure by eight 1000-hp. compressors

Texas sides of the field is handled by separate scrubbers, the latter being seven ft. in diameter by 25 ft. high. The plant is amply provided with inlet and outlet valves, all remotely controlled.

Water required in the operation of the station, and that used domestically at the camp, is obtained from four wells within the grounds, all approximately 650 ft. in depth and flowed by gas injection. On the camp site is a 5000-gal. steel tank to which the water is pumped, from whence it is discharged to the 16 modern cottages provided for the operating personnel. Adjacent to the auxiliary building is a 6000-gal. capacity overhead water tank for surge. A concrete basin alongside is employed to settle out sand discharged from the wells with the water. From this basin the water is boosted to the domestic tank by a 6 by 4 by 6 gas-engine driven pump.

One feature of the plant is the spacious, well-lighted, well-ventilated main compressor room. This structure, 230 ft. in length, 70 ft. in width, and 20 ft. high, is of steel construction for the most part, the exception being that the walls are of brick up to the sashes. Large windows on the sides and ends provide ample natural lighting, and electric lighting equipment for nights and cloudy days is entirely adequate. The building has a full basement in which is found the piping layout for the exhaust, intake air, fuel gas, starting air, and lubricating lines to the engines. The basement, too, is well lighted and ventilated. The engine room proper is equipped with two 10-ton overhead cranes for handling heavy equipment incident to the repair of the machinery.

An elaborate pipe line system has been constructed to bring the gas to the compressor station, transport it to the Myrtis gasoline plant, and on to the Latex station. The system is of varying sized pipe—16-in., 18-in., and 24-in., with the necessary 4-in., 6-in., and 8-in. laterals to the wells. The suction line to the station is of 24-in pipe, serving both the Louisiana and Texas sides of the field. Into this line, through the smaller diameter pipe, is fed the gas from the wells. Approximately 12 miles of 24-in. pipe was required. The discharge line between the compressor station and the gasoline plant, four miles in length, is of 16-in. pipe. Residue gas from the latter is sent to the Latex compressor station of the United Gas Public Service Company, north of Shreveport. For this purpose a 21-mile 18-in. line was completed recently. A 3-in. line also has been laid from the Rodessa compressor station to the Myrtis plant through which the drip removed from the gas at the station is transported to the gasoline plant.

To handle an increased volume of gas, the Myrtis gasoline plant of the United, constructed early in 1934, has been enlarged by the addition of equipment. The plant, which is of the absorption type, will now process 130,000,000 cu. ft. of gas daily; previously it handled 75,000,000 cu. feet.

The new equipment consists of four 170-hp. return tubular boilers; one 250-hp. vapor compressor; three 48-in. by 30-ft. absorbers; a main still complete with heat exchangers and preheaters, the unit having a processing capacity of 50,000 gal. of gasoline daily; a stabilizer unit with a capacity of 85,000 gal. of 26-70-lb. gasoline; 11 bays were added to the cooling tower, increasing the capacity from 2500 gal. per min. to 8000 gal. per min.; three 10-ft. by 40-ft. horizontal gasoline stock tanks of 25,000 gal. capacity each; one 5000-bbl. vertical storage tank; three 4-ft. by 20-ft. inlet scrubbers; three close-clearance feed and reflux pumps for the stabilizer unit; two 4-stage high-pressure oil pumps driven by 120-hp. steam turbines, one to be used as a standby; three 8-in. centrifugal water-circulating pumps driven by 50-hp. steam turbines. Loading facilities also have been enlarged. A railroad spur has been laid on the west side of the plant. Five new loading pumps have been added, two new loading connections made to the existing loading rack, and a 4-in. line laid from the plant to the rack. These additions, together with existing facilities, provide a loading capacity for handling 20 cars at one time.

Recent construction work also has included the plant's buildings. Twenty-four feet was added to the 36-ft. by 70-ft. boiler house, 20 ft. was added to the 32-ft. by 50-ft. compressor building, and a new steel pump house, 30 ft. by 40 ft., was erected.

D. R. Pflug was in charge as superintendent for the construction of the compressor station, and R. G. Murray was the construction superintendent for the gasoline plant work.

Interstage gas scrubbers at base of cooling tower

# Casing Cemented at Top and Bottom in One Operation » »

**By perforating the casing after cement is in place around the shoe, a second batch of cement is placed at the top to shut off surface formations**

By
R. M. COOK*

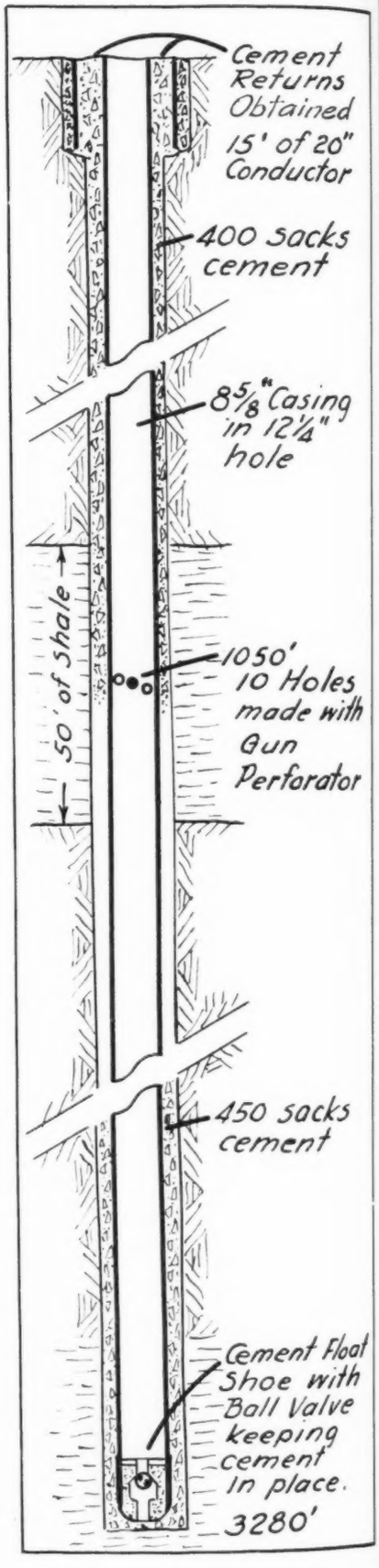
IN order to meet the requirements for cementing off all surface formations and at the same time cement 8⅝-in. casing as a water string in George K. Linderman Oil Company's well No. 3 at Redondo, California, it was decided that the best protection could be procured by placing the cement in two batches. One batch, of course, had to be around the shoe; the other extended from a shale bed at about 1000 ft. to the surface. The Pacific Oil Well Cementing Company was called on to do the job and developed the method that is illustrated in the accompanying sketch.

In addition to saving some of the cement that would be required for cementing the casing from top to bottom it was felt that a better bond could be obtained at the shale by placing the cement behind the pipe in two stages. The chances of channeling were thus reduced; and complete surrounding of the pipe at the shale bed where it was quite necessary was assured by forcing the cement in the upper stage out of the casing at that point. The long time of travel of the cement from the bottom of the string to the surface behind the pipe was also eliminated and this was felt to preclude any setting of cement on its way up. Another advantage provided by this method was that high pressure in placing the cement could be avoided. In this well a pressure of only 600 lb. was necessary for putting away the cement around the shoe and 300 lb. for pumping in the upper stage. With free circulation from the bottom to the surface it can be expected that the pressure required for the upper stage of cement will always be less than that necessary for pumping in the one around the shoe. This eliminates any possibility of forcing fluid through the back-pressure valve in the float shoe or float collar (whichever is used) and presents no hazard to the lower cementing job, which is followed up immediately by the upper job.

After checking the well log by use of the Geoanalyzer electrical logging equipment and accurately locating the shale bed, the string of 8⅝-in. casing equipped with a Baker float shoe was run in. As shown in the illustration, the hole was 12¼-in. in diameter and 3280 ft. deep. The first batch of 450 sacks of cement was then pumped in, a final pressure of 600 lb. being required.

As soon as this cement was in place the pressure at the surface was immediately relieved to check the back-pressure valve in the float shoe. This was found to have worked perfectly and further operation could proceed with the knowledge that the cement around the shoe would be kept in place without disturbance. A Lane-Wells gun perforator was then run and ten holes shot in the casing at 1050 ft.—about the center of the shale bed. This point was selected to insure a good bond in the shale above the perforations and allow any cement that might work down below the holes to remain in contact with shale.

Circulation through the perforations and up to the surface behind the casing was readily obtained and 400 sacks of cement were pumped in for the second batch. With cement returns being obtained at the surface, the upper plug was stopped before reaching the perforations. This gave assurance that the cement would seal off the holes in the pipe. A final pressure of 300 lb. was required for the second batch.


Cement Returns Obtained 15' of 20" Conductor
400 Sacks cement
8⅝" Casing in 12¼" hole
50' of Shale
1050' 10 Holes made with Gun Perforator
450 Sacks cement
Cement Float Shoe with Ball Valve keeping cement in place.
3280'

*President, Pacific Oil Well Cementing Company, Ltd.

# Toxic Gases and Their Effect as Lethal Hazards

By L. W. CLARK

THE first modern reliable writer, whose treatise on the chemistry of life appeared about the year 1800, was Sir Humphrey Davy. The medical properties of gases previously had been studied by Dr. Thomas Beddoes, whose treatise on the subject appeared about the year 1798. History recounts many instances of gas springs known to the ancients in the rugged places of Asia Minor, where they were much revered by early man as God-like mysteries. It is said Alexander the Great in his march to the east visited the gas springs to become intoxicated with its sweet pungency and pay tribute to the "God of Fire." This place is believed by geologists to be close to where are now the great Mosul oil fields.

Sir Humphrey Davy discovered a mixture of pure nitrous-oxide, which he called laughing gas, about the year 1799. Sir Humphrey says 16 quarts will produce hilarious intoxication if taken in seven minutes.[1] Making this gas known to his friends, and believing it to be entirely harmless, it was inhaled by prominent people and promised to become a fashionable intoxicant of the day.

There are numerous ways in which the human anatomy may react to toxic gases. It may cause a nauseating effect, as in the case of hydrogen sulphide, or it may cause a light sweet sickening sensation, such as often occurs when inhaled by gasoline plant and oil field workers in the course of their duties, or the gas may be almost odorless and strike with deadly effect like some of the war-time gases, or the deadly fumes of carbon monoxide.

Any of the commonly-known gases can cause a toxic condition and a very heavy dose gives lethal effect.

Many tests have been made to date on the poisonous effect of gases on animals. Fifty or more natural gases have been found that can have toxic or lethal effect.

### Carbon-Monoxide

Recently newspapers carried an account of a truck-driver found dead in the cab of his truck along the highway. A box of headache tablets lay on the seat beside him. Many were missing, showing he had taken them to ward off a severe headache. Investigation proved carbon monoxide had penetrated through the poorly constructed floor from an improperly fitted exhaust manifold.

There are many other places where the hazard of carbon monoxide gas is present. In the burning of oilfield waste enlarged smudges often may produce great quantities of it. An old-fashioned fire-place that will not draw smoke in damp and wintry weather is another. Poor ventilation in a camper's tent in which a light fire of any sort is used also may become a real hazard.

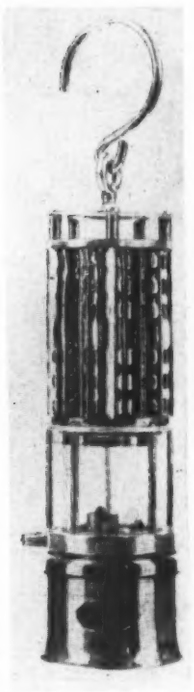
Investigators for the Cities Service oil group have found that absorbing small concentrations of carbon monoxide over a sufficient period of time results in drowsiness. This may or may not be accompanied by such warnings as a headache, dizziness, or nausea. A person breathing air containing 16 parts of carbon monoxide per 10,000 parts of air would be in the state of impaired judgment after an exposure of approximately three-quarters of an hour, in the state of collapse after an hour, and in the state of probable death after one and a half hours.[2]

Each year there are 500,000 unexplained automobile accidents and when accidents from sleeping at the wheel are on the increase liquor and high-speed cannot be wholly to blame. A driver in a pleasure car after several hours at the wheel drove into a safety zone and killed one person. He acted drunk. Police charged him with driving while intoxicated. The police physician, however, found no alcohol in the man's blood, but instead carbon monoxide.[3]

### Hydrocarbons

Most of the petroleum gases are not chemically active, and, consequently, cannot be considered poisoncus. When breathed in large quantities, or over an extended period, they usually have a tendency to cause unconsciousness because of their anaesthetic properties, or to act as simple asphyxiants due to the shutting off of oxygen supply.

The first four members of the paraffin series of hydrocarbons may be found in natural gas and refinery gas. These are methane, ethane, propane, and butane; and occasionally traces of the higher hydrocarbons will be found in these gases.



A modern safety lamp

### Physiological Action[4]

The lower hydrocarbons, such as those found in natural gas and the gas from petroleum and gasoline, act as simple asphyxiants when breathed for a sufficient length of time. They act by simply shutting off the supply of air through which the oxygen required for the normal body functions is obtained. These hydrocarbons are without direct action on the body tissues or the delicate structures of the lungs. They are anaesthetic gases that leave no serious after effects. Even when breathed in considerable quantities day after day the lower hydrocarbons produce no evidence of anything suggesting chronic poisoning. The reason for this is that these gases are chemically inert and lacking in tendency to promote organic decomposition.

### Hydrogen Sulphide[4]

Small quantities of hydrogen sulphide are found both in the gas and oil of many fields, but it is fortunate that excessive quantities are to be found in comparatively few districts. In most instances this gas is present in natural gas and oil in proportions of less than one percent; however, quantities of more than 15 percent have been found in some gases.

Under normal conditions hydrogen sulphide is a gas, and being somewhat heavier than air, it has a tendency to collect in pockets of low places where there is little or no air circulation.

Hydrogen sulphide is known to be a very dangerous poison and may

**There are many instances when it is wise to use a gas mask**

prove fatal if the air breathed contains more than a trace. Irritation and inflammation of the eyes, throat, and lungs have resulted from breathing as little as 0.005 percent, while a concentration of 0.06 percent is considered high and dangerous.

Cases of hydrogen sulphide poisoning are classified as acute and subacute. The subacute cases result from brief exposure, and when the concentration is not high. The acute condition results when the person has been exposed for some time, usually to a high concentration of the gas.

When the quantity of hydrogen sulphide is low, 0.005 to 0.02 percent by volume, and the exposure is brief, a smarting of the eyes, headache, and nausea may occur; longer exposure usually causes irritation of the eyes, throat, and lungs, which often incapacitates the victim and may result in illness and even death. If exposed to a high concentration, above 0.05 percent, asphyxiation almost invariably results, followed by death. The bad odor of this gas is distinctive and men should not work without protection when the odor is strong; however, odor alone is not a reliable warning, because a person accustomed to working in the presence of hydrogen sulphide soon loses the sense of smell and increase in the concentration of the gas may pass unnoticed.

A very striking property of this kind of poisoning is the rapidity with which the virulent condition advances from irritation through depression and stupor into unconsciousness. This fact suggests that treatment of a person showing signs of hydrogen sulphide poisoning should be prompt, as a few minutes delay may prove fatal. Fresh air is necessary and artificial respiration should be given while waiting for the arrival of a physician. The most prominent characteristic of the gas is its very objectionable odor.

An atmosphere containing more than 0.2 percent hydrocarbon gas or vapor cannot be breathed by the average individual for any considerable length of time without danger of asphyxiation.

When hydrogen sulphide is taken into the body it combines with the sodium in the cells to form sodium sulphide. Irritation follows because of the abstraction of the alkali, and because of the sodium sulphide, which is caustic to the flesh. Part of the sodium sulphide is absorbed through the membranes of the respiratory system and enters the blood stream. It is there decomposed with the liberation of hydrogen sulphide. If hydrogen sulphide is passed through blood a dark green pigment is deposited, probably a compound formed by the union of sodium sulphide and the iron of the blood. The treatment of acute hydrogen-sulphide poisoning is the same as for asphyxia as outlined under hydrocarbons.

**Symptoms:** Inhalation of vapors causes coughing, irritation of eyes, and loss of sense of smell (within two to 15 minutes); higher concentrations cause coughing, collapse, unconsciousness (one-half to two minutes), and death from paralysis of the respiratory center. Inhalation of non-lethal concentrations also may cause pulmonary irritation, followed by chemical pneumonia and edema of the lungs. Repeated or very low concentrations cause conjunctivitis.

**Treatment:** The treatment for acute poisoning by inhalation is as follows: (1) Remove to pure atmosphere; (2) administer artificial respiration followed by an oxygen-carbon dioxide mixture containing seven percent carbon dioxide; (3) administer teaspoonful of aromatic ammonia in one-third glass of water; (4) summon a physician.

Treatment for the eyes should be directed towards relief of pain by drops of butyn, or holocain (in severe cases); alternate hot and cold compresses also aid in acute cases. In old cases resulting from long exposure, boric acid ointment is valuable; drops of argyrol (four to ten percent) also are helpful in such cases.

### Chlorine[4]

Chlorine is used in the petroleum industry mostly in the liquid form, being received in cylinders or tank cars, and to some extent combined with lime or sodium as the hypochlorite for the treatment of gasoline. It is a powerful irritant poison, acting upon the membranes of the eyes, nose, and throat. A concentration of 40 to 50 parts per 1,000,000 is dangerous for a short exposure and 1000 parts per 1,000,000 is rapidly fatal. Very small quantities, three to four parts per 1,000,000, are detected easily by the characteristic odor.

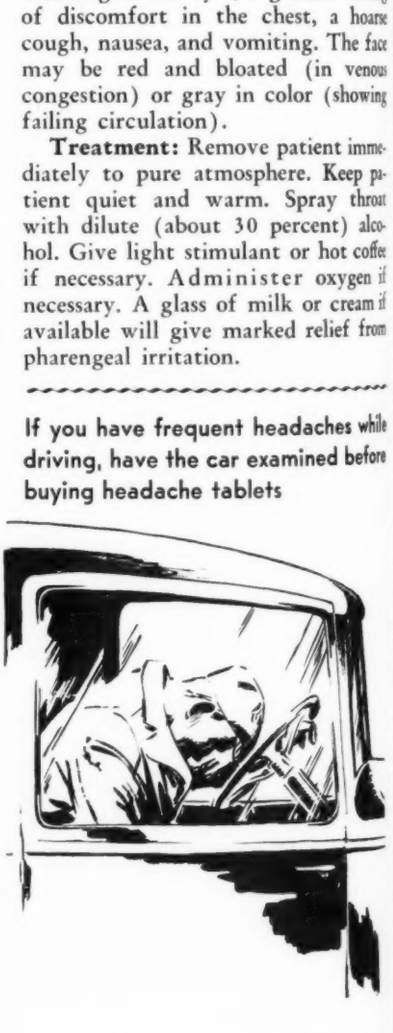
Mixtures of gasoline and chlorine react slowly in the absence of light, but even if slightly warmed the reaction is sudden. The mixture may flash into incandescence with the separation of carbon and hydrochloric acid. Brooks demonstrated the explosive nature of such a mixture by adding 82 deg. A.P.I. gravity gasoline to chlorine in a cylinder, exploding the cylinder with terrific violence.

It is important that means be provided to prevent gasoline mixing with the chlorine; that is, the chlorine should always flow into the gasoline. Adequate safety traps should be set in the supply line and the chlorine cylinder disconnected from the system when not in use.

**Symptoms:** The symptoms of chlorine poisoning are coughing, smarting of the eyes, a general feeling of discomfort in the chest, a hoarse cough, nausea, and vomiting. The face may be red and bloated (in venous congestion) or gray in color (showing failing circulation).

**Treatment:** Remove patient immediately to pure atmosphere. Keep patient quiet and warm. Spray throat with dilute (about 30 percent) alcohol. Give light stimulant or hot coffee if necessary. Administer oxygen if necessary. A glass of milk or cream if available will give marked relief from pharengeal irritation.

**If you have frequent headaches while driving, have the car examined before buying headache tablets**



"The points to be clearly understood in connection with the treatment of asphyxia are that the essential condition consists, not in cessation of breathing, for respiration continued almost to death; but in the interruption of the supply of oxygen to the tissues of the body, and especially to the brain. In this respect asphyxia by gases contrasts with drowning and electric shock. In both of those conditions spontaneous respiration is the supremely important measure of assistance. Inhalation of oxygen and carbon dioxide is then merely a useful accessory. After a prolonged severe asphyxia, on the contrary, the victim, unless irretrievable, is generally breathing spontaneously, although poorly. The administration of oxygen alone is not very effective, for the reason that it is not inhaled in sufficient volume. The carbon dioxide mixed with the oxygen acts, however, as a powerful respiratory and cardiac stimulant. It both replaces the carbon dioxide that the body has lost and by the increase of respiration induces a deep and full inhalation of the oxygen with which the carbon dioxide is mixed."

### Antidote for Carbon Monoxide Poisoning[5]

Successful use of methylene blue solution at several points on the Pacific Coast during late December and January in the treatment of carbon monoxide poisoning comes as news of first importance to the medical and gas professions.

About the middle of December, following tests at the University of California in use of methylene blue dye on animals asphyxiated with carbon monoxide, an order was issued by Dr. J. C. Geiger, director of public health for the City and County of San Francisco, calling for this treatment in all cases of carbon monoxide poisoning received in San Francisco emergency hospitals.

What is understood to be the first case of record in which the antidote has been successfully used in the treatment of human beings occurred on December 30 at Park Emergency Hospital, San Francisco. Allen D. Maybry, 54 years of age, had inhaled fumes of his automobile in his garage in a suicide attempt, according to newspaper reports, and apparently was dead for a half hour prior to the methylene blue injection. A meter reader found him and used artificial respiration for 30 minutes without reviving him. He was then taken to the hospital, an intravenous injection of methylene blue made, and heartbeats were noticeable within three minutes. In two more minutes the heart was beating audibly and in less than ten minutes the patient's eyes opened.

Initial application of methylene blue in Los Angeles was made at the Georgia Street Receiving Hospital, four persons who had been overcome by fumes from gas heaters receiving injections on January 24. All victims had been rendered unconscious by carbon monoxide, the condition of one in particular being regarded as very serious. Two of the milder cases were released from the hospital soon after the treatment. Little hope was held for one of the cases, but this patient also revived later the same day.

An emergency injection of methylene blue was made in Pasadena, California, at the Pasadena Hospital, on January 29, the victim having been pronounced beyond the aid of ordinary antidotes. This patient regained consciousness 15 minutes after the injection. The patient had been suffering from a serious attack of influenza when overcome by carbon monoxide gas, and chemical analysis of his blood at the hospital showed that it contained the gas in a quantity ordinarily fatal.

The use of methylene blue, according to information furnished by Dr. Jacques P. Gray, assistant director of public health for the City and County of San Francisco, was first suggested in connection with treatment of cyanide poisoning. Its application for carbon monoxide poisoning is regarded in the experimental stage as far as humans are concerned. It is stated further that use of artificial respiration in connection with some of the San Francisco cases thus far treated with methylene blue should receive recognition.

Dr. Geiger of the San Francisco Department of Health suggests a 50 c.c. dosage of one percent methylene blue solution in physiological salt solution, injected intravenously, to be repeated in from 15 to 30 minutes if necessary. The method of treatment for cyanide poisoning has been described by Dr. Geiger in an article appearing in the *Journal* of the American Medical Association for December 3, 1932.

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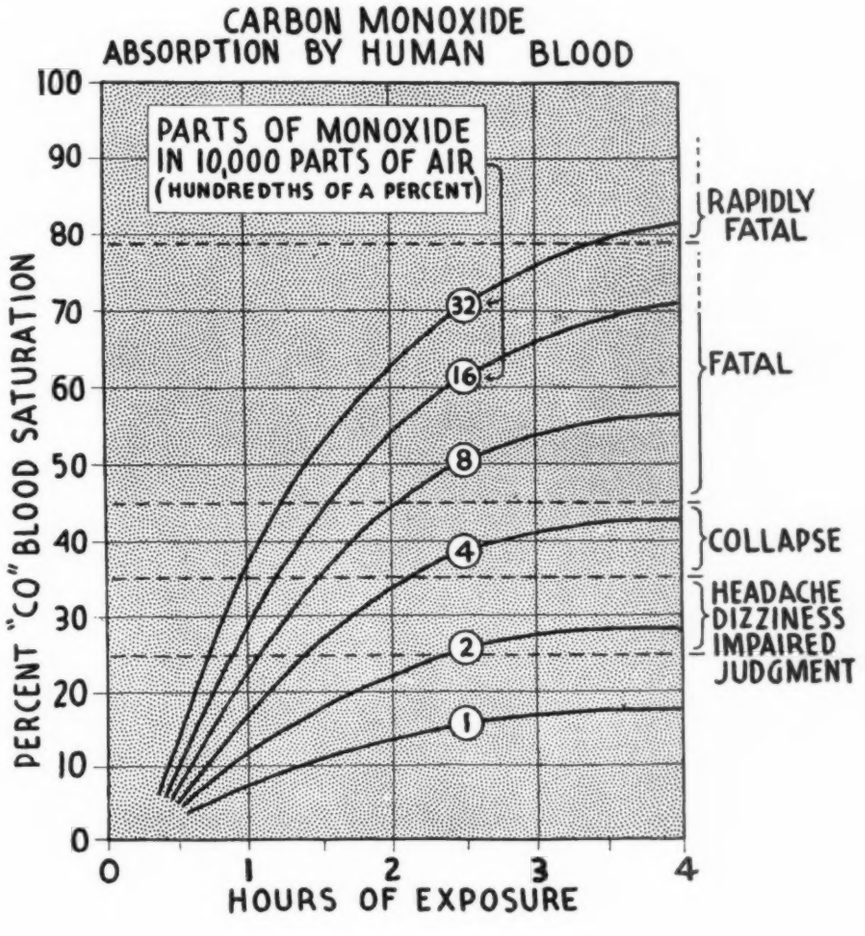
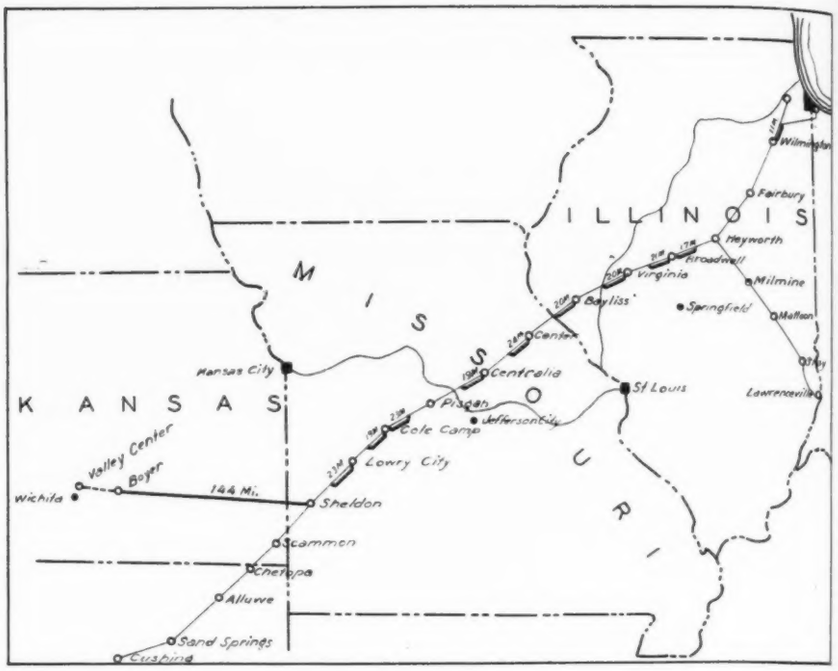



Showing the effect of carbon monoxide gas on the human body

Map showing the extensions and additions to the Texas-Empire Pipe Line Company's system




# Capacity of Oil Trunk Line Increased

By
LEO H. TOWERS

## Construction Methods Used When 144-Mile Extension and Main Line Loops Added

THE TEXAS-EMPIRE Pipe Line Company has just completed additions and extensions to its oil trunk line that will increase its daily capacity by 18,000 bbl. to a maximum of 90,000 barrels. The original 12-in. line from Seminole and Cushing, Oklahoma, to Chicago and other Illinois points was constructed in 1929 and for some time has been running at its full capacity of 72,000 bbl. daily. Additions to the line include some Empire properties in Kansas that have been taken over, the construction of 144 miles of new 10-in. line in Kansas, and the addition of ten "loops" to the main line, totaling 197 miles, between Sheldon, Missouri, and Manhattan, Illinois.

The increased volume of oil will come from the active western Kansas pools. The actual starting point of the line is at Valley Center, Kansas, where the Bright pump station of the Empire Pipe Line Company has been taken over by the Texas-Empire. This station already was connected with lines from fields to the northwest. From Valley Center to Eldorado a 12-in. line formerly belonging to the Empire will be utilized.

At Eldorado a portion of the Empire's Boyer station will be used and, in addition, an extension to the station building has been made to house an additional pump. This 5¼ by 18 Worthington horizontal duplex, motor-driven pump will be augmented by two smaller electric-driven pumps already installed in the building.

From Eldorado a new 10-in. line has been laid in a direction almost due easterly to the Sheldon, Missouri, station on the main line. This line was constructed of 144 miles of A. O. Smith Corporation 28-lb. electric lap-welded pipe. For purposes of construction the line was divided into three sections. From Boyer Station to Toronto, Kansas, a distance of 51 miles, the contract was let to the Truman-Smith Construction Company of Eldorado. This section was electric-welded. Three river crossings were made; the Walnut River was crossed at Eldorado, and Walnut Creek and the Verdegris River were crossed at Toronto, near the end of the section.

Making the Walnut Creek Crossing near Toronto, Kansas

Shop-fabricated tie-in assembled and ready to place in the main line (on left). Scraper box is included for the loop section

For the river crossings heavier seamless pipe, with river clamps attached, was used. Due to extremely dry weather the rivers were at a low stage and little difficulty was experienced in making the crossings. Highway crossings were cased in the usual manner and vented. Coating was used on the line only at the river crossings and other predetermined "hot spots." At these points a primer coat was applied followed by a hot coat of enamel, and a loose wrapper of felt completed the protection.

From Toronto to Savonberg, a distance of 44 miles, the line was laid by the Oklahoma Construction Company of Dallas, Texas. This section of line was Lindewelded. Six acetylene generating machines mounted on trucks were used by the contractors to supply the welders. The only river crossed on this section was the Neosho River, near Chanute, Kansas.

The final section on this extension was from Savonberg to Sheldon, Missouri, a distance of 49 miles. Contract was let to Truman-Smith Construction Company and like the first section was electric-welded. On all sections of the line firing-line sections consisted of five joints of pipe, each 40 ft. in length. Despite the fact that unusually high temperatures prevailed during construction little delay was caused by the heat. Temperatures ranged from 100 deg. to 120 deg. and much of the country crossed was void of trees and shade. Contractors reported no heat prostrations. The line was completed and ready for operation August 20th.

### Main Line Loops Added

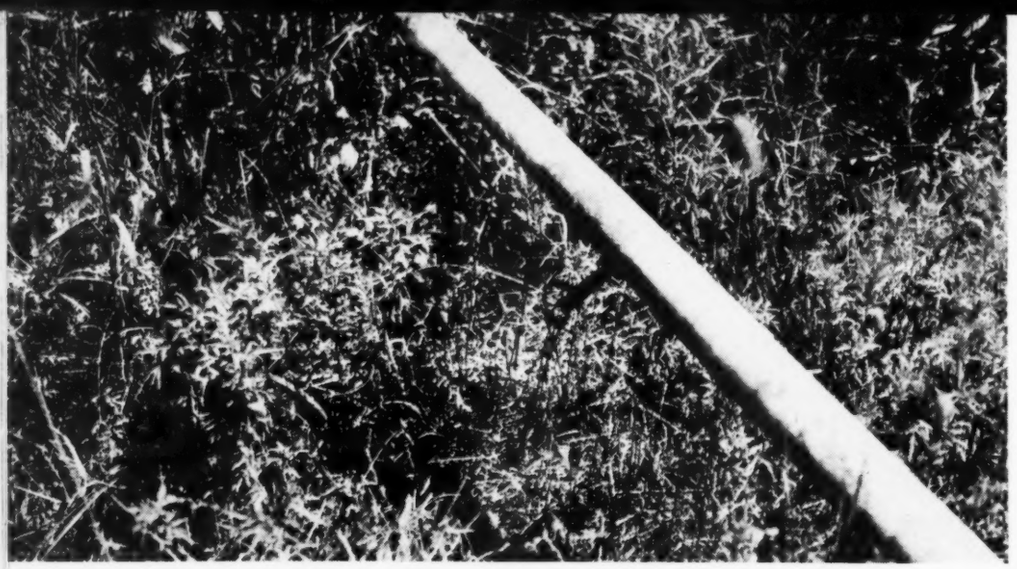
From Sheldon Station north to Chicago on the main line 197 miles of 12-in. "loops" were added in ten different sections, as shown on the accompanying map. Republic pipe weighing 33 lb. per ft. was used on these "loops," except for two "loops." On these two sections, on the discharge sides of Cole Camp and Broadwell stations, pipe weighing 40 lb. per ft. was used. All pipe was given a protective coating in the field. This coating consisted of a primer coat, hot enamel, and loose felt wrapping. Contractors on these "loops" were Williams Bros. of Tulsa, five sections; Kelley Dempsey Company of Tulsa, one section; Jones-Brooks Company of Oklahoma City, two sections; and the Truman Smith Construction Company of Eldorado, two sections.

Station facilities on the line will be taxed to capacity to pump the 90,000 bbl. daily through the line. All units at the Diesel-driven stations will be in operation and at the intermediate stations having electrically-driven centrifugal pumps the size of the impellers has been increased. At Heyworth, Illinois, the junction point for lines to Chicago and Lawrenceville, a Worthington plunger pump of 20,000-gal. capacity has been added.

All "loops," with the exception of one on the north end of the line, were tied into the main line at one time. The "out of service" time for the line while the tie-ins were being made was less than 18 hours. A shop-fabricated tie-in consisting of cross-over, scraper box, and gate valves was assembled in one piece. Two cuts were made of the main line, the section removed, and the assembled tie-in slipped into place and welded to the main line, thus completing the job.

All construction work was under the supervision of F. A. Stivers, general superintendent of the Texas-Empire Pipe Line Company; J. L. Culbertson, chief engineer, and A. J. Love, field superintendent.

Tractors handling the 5-joint sections of 10-in. pipe with ease



A section of heavily galvanized 2-in. lead line South of Lawrenceville, Illinois, showing plugs driven into pin holes after being in service about seven months

By
J. C. ALBRIGHT

Frequent Replacements of Well Tubing and Lead Lines Eliminated

# Cement-Lined Pipe Overcomes Corrosion Trouble in Illinois Field

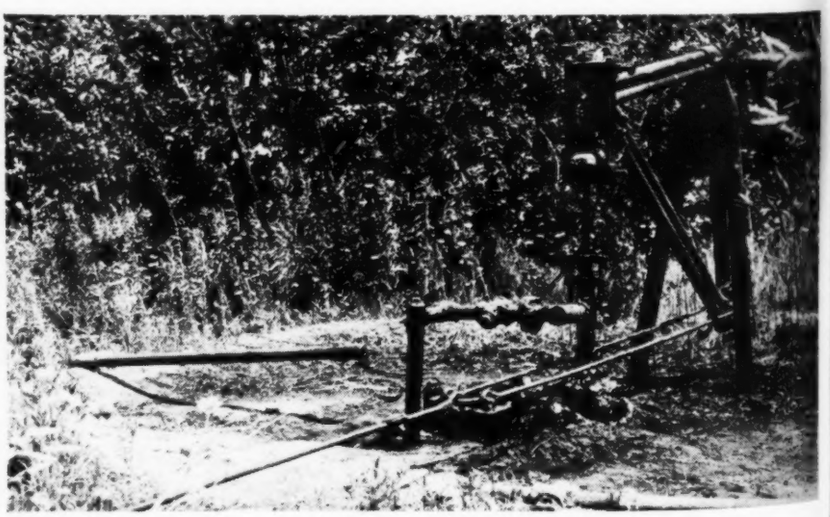
IN Eastern Illinois the Ohio Oil Company is operating properties the production from which is extremely corrosive to pipe, due to deleterious chemicals in the oil and brines pumped from old wells. The portion of the area most corrosive to equipment is south of Lawrenceville approximately three miles, on the W. E. Robbins farm. In this "hot spot" it is not unusual to replace the ordinary type of 2-in. lead lines twice each year.

The oil contains hydrogen sulphide, and the water produced with the oil carries a high percentage of calcium, sodium, and magnesium chloride. Corrosion begins to affect the well equipment just above the working barrel, the tubing deteriorating rapidly; but the greatest damage is done in the lead lines from the wells to the lease tank batteries. Attempts have been made to prevent corrosion of lead lines by laying sections of heavily galvanized pipe, but as soon as the plating was removed by erosion and corrosion, the pipe itself disintegrated quite rapidly. Numerous lines in the district are laid on top of the ground, both black and galvanized pipe, with wooden plugs driven in the walls where pinholes have appeared to prevent the loss of oil while it is being pumped from the wells to receiving tanks.

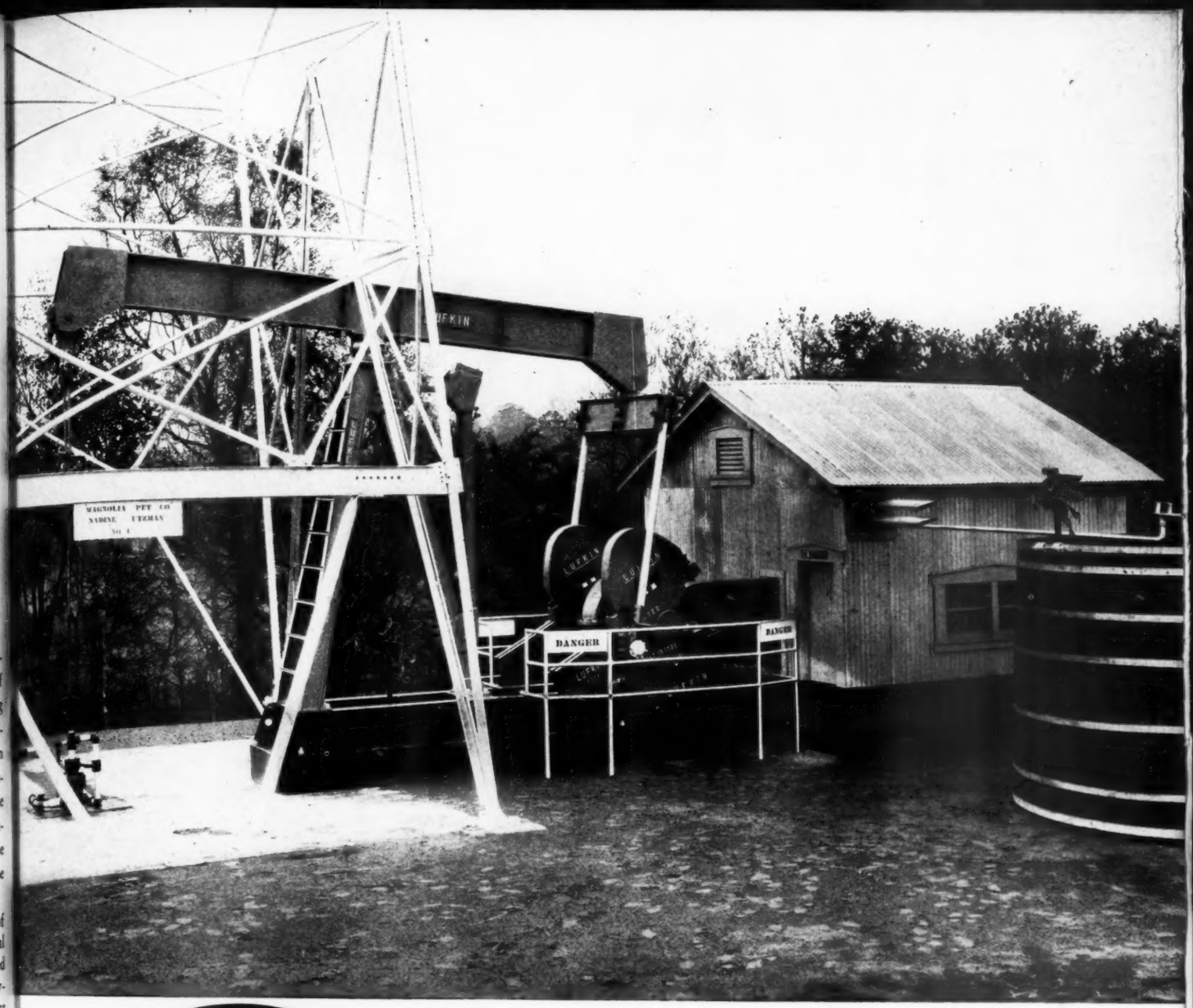
Tubing in some of the wells in the district deteriorates more rapidly than the lead lines, especially the first few hundred feet above the working barrels, and some operators, other than the Ohio Oil Company, are using a specially prepared pipe to replace strings found leaking. This pipe, manufactured by the National Tube Company, and called Duroline, is finished with a uniform coating of cement applied to the interior under pressure. Where this pipe is employed, lead lines are similar to the usual grade of pipe weighing 3.75 lb. per ft., but with the interior coating of cement the weight is increased to 4.63 lb. per foot.

The first cement-lined pipe was used for this purpose by the Ohio Oil Company in 1932. It replaced 1000 ft. of ordinary line pipe that was carrying natural gasoline having corrosive qualities as a result of hydrogen sulphide in the crude. In 1935 this line was removed for inspection to determine whether the coating was seriously damaged. Pipe line engineers found the coating to be approximately of the original thickness.

The second use made of this type of line pipe was in 1935, 10,000 lineal ft. being installed to replace corroded lead lines in a certain area south of Lawrenceville where corrosion was most severe. In July, 1936, a carload of this pipe was being unloaded and strung in the field, installed as rapidly as the men on the various leases could excavate ditches and make the necessary con-



A well near Lawrenceville, Illinois, about to be equipped with cement-lined pipe

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**Ditches excavated on Ohio Oil Company's W. E. Robbins Farm, South of Lawrenceville, Illinois, for cement-lined pipe strung ready to be connected as lead line.**

nections. The original 1000 ft., removed from the gasoline line, was used to replace corroded pipe, and during a recent inspection it was found that no leaks had developed.

In making up this pipe, equipped with collars and threads, a special joint compound is employed that effectually seals the threads and prevents corrosive elements in the oil and water from reaching this part of the pipe. Naturally more than the normal amount of care is exercised in handling this pipe than when laying the usual line pipe, so that the cement lining will not be damaged.

In those instances where tubing was replaced with cement-lined pipe, insufficient time has elapsed to determine its effectiveness for this use. Due to the added wall thickness of cement-lined tubing, tubing of larger diameter is required to permit the running of traveling valves and rods. Those who have installed cement-lined tubing are expecting virtually the same results as obtained by its use in line pipe service.

**Passing a holiday detector over pipe for the purpose of locating faults in the coating**

# Holiday Detector Makes Positive Check on Pipe Line Coatings

PIPE line coatings are easily and accurately checked with the "holiday detector," a device widely used in construction work. The detector is the outgrowth of what once was called the "doodle bug," used by operators for locating unauthorized taps off the main line, and for finding lost lines. It has the advantages of being easy to construct, portable, inexpensive, simple in field operation, and positive in its detection. Carried in a wooden box that is provided with a sling for carrying over the shoulder, the detector consists mainly of a regular automobile 6-volt storage battery, coil, and knife switch. Two binding posts on the box permit attaching two lead-off wires. To the free end of the ground wire is a clamp for attaching to a clean, uncoated, free end of the pipe to be tested. The other wire leads to the detector proper.

The detector is made of two wooden handles, each riveted to a half-circle metal ring. The two sections of the ring are hinged together so that opening and closing the handles will open and close the ring in the same manner as a pair of pliers. This ring is about eight inches larger in diameter than the pipe to be tested. Welded to this ring on the inside is a brush of fine wire; the wires being long enough that their loose ends will drag along the surface of the coating. The positive wire, with insulated covering, is attached to this metal ring.

To operate, the workman encircles the pipe by opening the handles wide enough to slip the ring over the pipe, closes, and pulls along the coated pipe. The ground wire being attached to the metal pipe any void or holiday in the coating will permit one or more of the wires in the brush to contact the bare pipe, completing the electrical circuit. When the circuit is complete the coil sets up a warning signal and the painter following the detector operator immediately covers the exposed void. In this manner small holidays that so often cannot be detected with the eye are quickly found.

# Drilling Mud and Heaving Shale

By
K. H. CLOUGH*

**Methods of conditioning mud for lost or impaired circulation —types and characteristics of heaving shale — actual data on mud treatment at drilling wells.**

IN discussing the various properties of drilling muds in the September issue it was shown how a mud of low viscosity can be disadvantageous from two standpoints: first, when it is necessary to stop circulation, and second, when circulation is lost or impaired. The first disadvantage mentioned was taken up in the September article. The second disadvantage will now be discussed.

When circulation is lost or impaired, as in the case of a porous formation being encountered, the danger of sticking the drill stem is not so great. In this event the mud, and with it the suspensoids, penetrates the porous bed and does not compact above the bit and around the stem. The circulation is lost through the removal of the mud and the suspensoids. Under drilling conditions where a porous formation is encountered and circulation lost, this loss is due to the fluid (low viscosity) condition of the mud, since the mud flows out of the hole and into the formation as fast as it is pumped into the well.

The loss of returns becomes evident soon after such a formation is entered, but restricted circulation usually can be maintained. If the drilling is continued with the restricted and imperfect circulation, the cuttings will not be thoroughly removed from the bit. Only with the circulation at its best can the cuttings be thoroughly flushed from the hole. The returns under such continued drilling generally will continue to decrease as the porous bed is penetrated to a greater depth.

Such porous formations usually act as a filter for the mud fluid and most of the suspended matter will be deposited on the exposed portion of the formation in the well; also, it may be observed that the tendency of the mud to gel is important, because as the mud enters the porous formation and becomes relatively quiet whatever gelling quality the mud has will tend to close the openings and prevent the loss of the returns.

The colloidal material present in the mud will pass into the formation in its colloidal form. If the deposit formed on the surface by the suspensoidal content becomes sufficiently compact, it will retain a part of the colloidal material and eventually become impervious. In this case returns never will become lost completely except in a very porous formation, and soon after the drilling has progressed beyond this porous formation and the openings have been closed sufficiently through deposition, the returns gradually will increase until they reach their normal volume.

In extreme cases, however, where the formation encountered is of an extremely porous nature and the mud contains little or no colloidal material, returns will begin to decline appreciably as soon as the porous formation is penetrated and will become progressively smaller until they are lost completely.

During such a decline, due to part of the returns entering the porous formation, the resultant linear velocity of the mud upward in the well just equals the settling rate of the suspensoidal particles. Then the possibility of sticking the drill stem becomes imminent. Any further decline of returns will result in the cuttings settling in the hole and the drill stem and bit becoming wedged, unless they are withdrawn immediately. Such a condition obviously is a fault of the drilling mud and can be remedied by increasing the colloidal content of the mud, to do which several methods are available:

1. By the addition of a commercial colloidal material or even a good colloidal clay.

2. In the event of sufficient weight (sufficient colloidal material) but with an absence of either gelling tendencies or that degree of fluidity conducive to satisfactory handling, a chemical treatment is indicated. Any of the following chemicals may be used: quebracho extract, brown sugar, sodium silicate, sodium carbonate, sodium hydroxide, mono-sodium phosphate, di-sodium phosphate, tri-sodium phosphate, or various other chemicals.

The condition mentioned in method (2) is found when the colloidal material present is in a coagulated condition and the above-mentioned chemicals are used to disperse the coagulated particles. At least 22 chemicals now are employed in mud treatment, either singly or in various combinations, so the possibility of chemical treatment offers a wide field; however, in general, it may be stated that if it is possible, chemical treatment should be avoided. Occasionally disastrous reactions may occur, resulting in a lost hole.

The addition to the mud fluid of colloidal material such as mentioned in method (1), though serving to prevent the loss of returns by increasing the sealing and gelling tendencies, also tends to increase the viscosity. Since the settling rate of the suspensoidal material is inversely proportional to the viscosity of the suspending medium, an increase in the colloidal content of the mud will retard the settling rate of the cuttings; however, as long as the mud remains in the liquid state and as long as the gravity of the liquid phase does not exceed that of the suspended particles, such particles will settle out and be dropped in the ditch or slush pit.

Should the specific gravity of the liquid phase equal or be greater than that of the suspensoidal particles, the cuttings will not settle out but will be carried until the mud can no longer be pumped. This will result in more power consumption and considerable abrasion of the pump parts. Treatment with the various chemicals, such as quebracho extract, etc., allows a greater suspensoidal content for the same viscosity or a lower viscosity for a given suspensoidal and colloidal content and will permit the cuttings to be dropped.

A good colloidal mud, however, possesses an additional property that is of great importance in the drilling of deep wells. When allowed to stand quietly for a short period it will set to a soft gel. While in this plastic state, the properties of the mud are entirely different from those of the liquid state. In this condition there is no possibility of the cuttings settling out and the viscosity and all other

*Chemical Engineer, W. H. Curtin & Co., Houston, Texas.

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physical characteristics are altered completely. The chemical properties of the mud, however, seem to remain the same, but its response to chemical treatment is slower than in the fluid state. In the plastic state the mud possesses sealing properties that make it valuable wherever porous formations, fissures, or voids are encountered —provided that such voids are not so large that the pump velocity is insufficient to fill the openings.

Natural muds, usually made from native clays, do not as a rule have the sealing properties necessary for deep drilling where fissures and porous formations have to be dealt with. These are treated with bentonitic clays and barium compounds. The cost of such drilling muds varies with the amount of natural clays that can be used and with the amount of weighting material that must necessarily be added. With mud costing in the upper price range, recovery plants have been established in some fields and the weighting materials recovered. Such is the practice in the Ventura Field, California, where muds ranging in weight from 8.6 lb. per gal. to 12.6 lb. per gal. are used.

### Heaving Shale

Heaving shale probably has given production engineers more trouble than any other formation. For the sake of explanation, heaving shale may be divided into three types:

1. Compact—This is the least objectionable of the three forms. Usually it has sufficient resistance to crumbling so that it will hold together if the proper drilling mud is used. This particular type of shale, consisting of alternate layers of shale and bentonitic clay, swells in the presence of water. The swelling continues until the pressure becomes so great that the shale gives way and caves into the hole, as this direction offers the least resistance to the pressure. This crumbling action, due to absorbed water, is termed heaving, and once started is very difficult to halt.

2. A brittle shale, also known as heaving shale, but differing from the compact form in that it washes or breaks away in small pieces. As circulation continues, more and more breaks away, an action that eventually results in an overhang of compact material above with but little support. When that gives way, the overhang crumbles into the hole on top of the bit and may result in sticking the tools. Such a shale formation is difficult to wall satisfactorily and to make hole through.

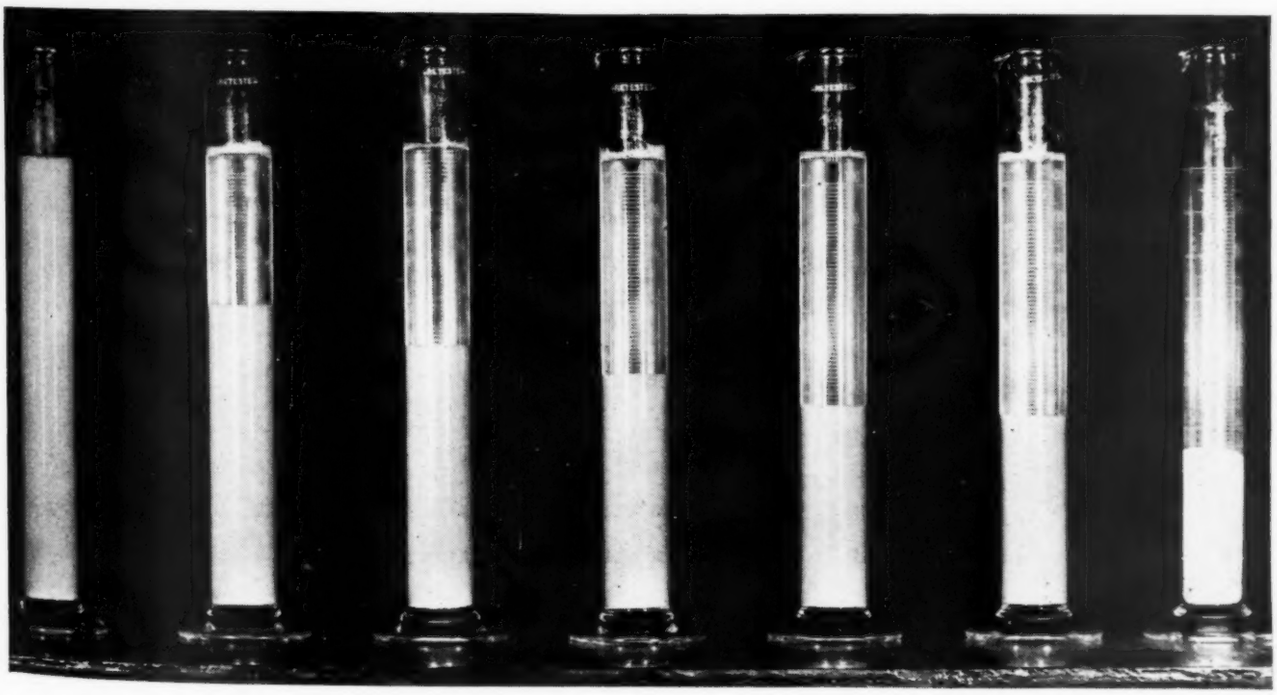
3. This type of shale contains some bentonitic material and differs from the other two types in that it is very sticky and tends to ball-up on the bit. This fact, plus its tendency to swell in the presence of water, makes the drilling of it doubly difficult.

At present the practice in combating heaving shale is to use drilling muds of light weight and of high viscosity with a relatively high pH, and as little free water as possible. The high viscosity mud serves to seal the wall with a thin, fairly flexible coating that prevents water entering the formation and also holds back the shale.

In experiments with bentonitic materials, which comprise a large part of heaving shale, the writer has found that the addition of salt solutions to the water in which such material is dissolved would reduce the swelling. It is this swelling characteristic of heaving shale that causes the trouble experienced in drilling it. Fig. I shows seven graduates. In the graduate on the extreme right is 35 cc. of bentonitic material, the amount in each graduate. The graduate on the extreme left was filled with distilled water. In the other graduates, reading from left to right, salt solutions were placed. It is interesting to note the obvious reduction in swelling as the percentage of sodium chloride was increased.

From left to right: Graduate 1, distilled water; graduate 2, one percent salt solution; graduate 3, two percent salt solution; graduate 4, five percent salt solution; graduate 5, seven percent salt solution; graduate 6, ten percent salt solution. The last graduate con-

**Fig. I. An experiment showing how the tendency of bentonitic shale to heave is affected by salt solutions of various concentrations. Graduate on left contains 35 cc. of bentonitic shale in distilled water—graduate on right contains 35 cc. of bentonitic shale only. The intervening graduates have each 35 cc. bentonitic shale in salt solution—the concentration increasing from left to right (See text).**



tains 35 cc. of the bentonitic material dry.

Laboratory tests made by the writer have shown that in amounts up to 0.4 percent the addition of sodium silicate will produce lower viscosities of drilling muds and in amounts in excess of 0.4 percent there is a tendency to coagulate the colloids. More harm than good results from the addition of amounts larger than 0.4 percent; furthermore the addition of an equal amount of commercial gel material will tend to increase the gelation and the settling. This material seems to have no reversal of form and the addition of greater or lesser amounts has more or less effect but always in the same direction. It also was observed that quebracho extract would lower the viscosity of the mud. Some experimentation has been done with a view to using quebracho extract to lower the viscosity of the slurry in making cement with the idea in view of increasing the solid content of the slurry without increasing the pump pressure required to handle it and to cut down fuel loss through the necessity of evaporating a large amount of water in relation to the solid content.

Some actual data from drilling wells are given below to show about the type and amount of treatment given to the drilling mud for depths less than 7500 feet.

WELL NO. 1

| | | |
|---|---|---|
| Specific gravity of mud | 1.32 | |
| Weight of mud | 11.0 | lb./gal. |
| Viscosity (Marsh) | 39.0 | seconds |
| Gelling | None | |
| Settling | None | |

Seventy lb. of 40 percent (commercial) sodium silicate equaling approximately .04 per cent by volume was added to the drilling mud and on being tested it was found now to have the following characteristics:

| | | |
|---|---|---|
| Viscosity | 24.0 | seconds |
| Gelling | None | |
| Settling | Good | |

The viscosity of the mud at this point was very good and the settling good. Prior to the addition of the sodium silicate the viscosity of the mud had been high and the settling unsatisfactory. The gelling in both cases was bad and so 1000 lb. of commercial gelling material was added to the mud to increase the gelling properties. This helped the gelation but increased the viscosity somewhat and cut down the settling. At a lower depth a gumbo formation was encountered, the cuttings from which increased the viscosity of the drilling mud and necessitated the addition of 40 lb. of sodium silicate. This was not a deep test and the above material was all that was added to the drilling mud for this well.

WELL NO. 2

| | | |
|---|---|---|
| Specific gravity of mud | 1.21 | |
| Weight of mud | 10.2 | lb./gal. |
| Viscosity | 97 | seconds |
| Gelling | very rapid | |
| Settling | slight | |

Only 400 cc. of mud was run in the above viscosity test. To the drilling mud above was added 225 lb. of sodium silicate and a test of the mud showed the following characteristics:

| | | |
|---|---|---|
| Specific gravity of mud | 1.22 | |
| Weight of mud | 10.3 | lb./gal. |
| Viscosity (500 cc.) | 65 | seconds |
| Gelling | Rapid | |
| Settling | Slight | |

Four days later it was necessary to add more sodium silicate; 265 lb. more was added, making a total of 490 pounds.

| | | |
|---|---|---|
| Specific gravity of mud | 1.25 | |
| Weight of mud | 12.1 | lb./gal. |
| Viscosity | 95 | seconds |
| Gelling | Rapid | |
| Settling | Slight | |

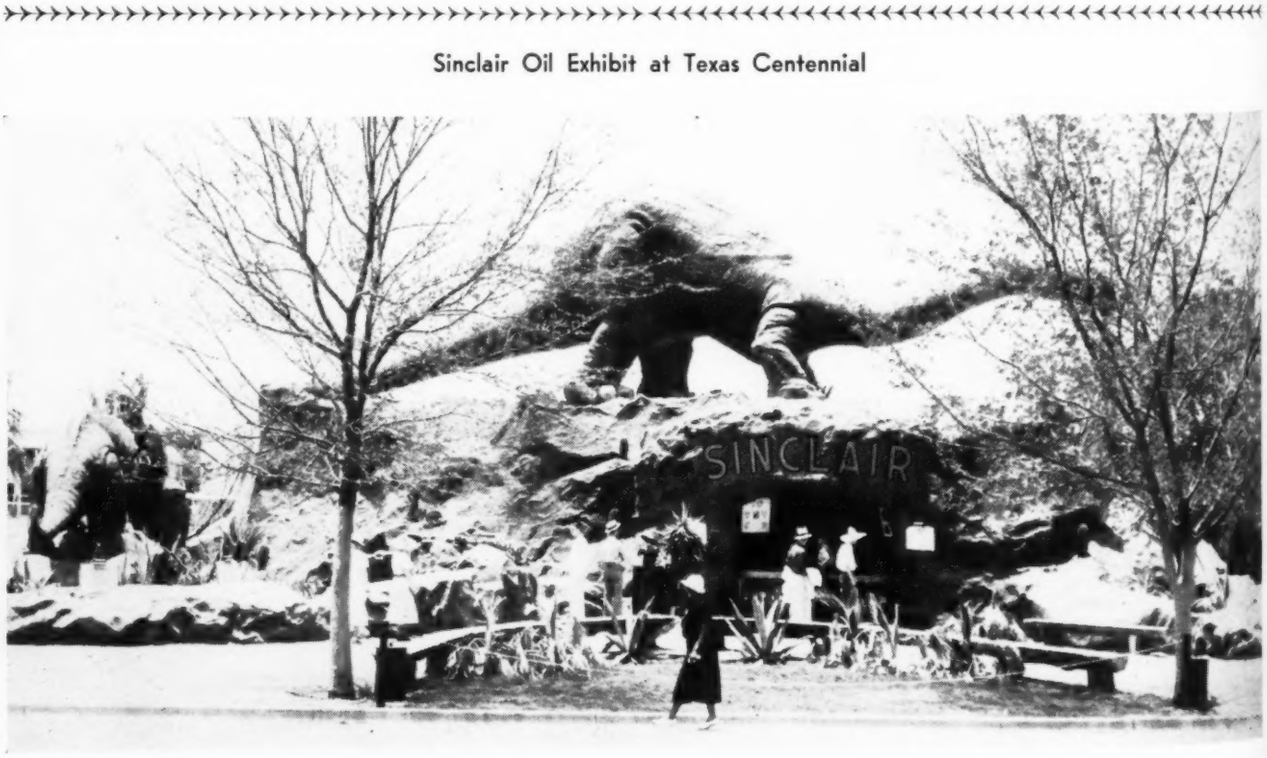
An additional 170 lb. of sodium silicate was added and three days later the following data were obtained:

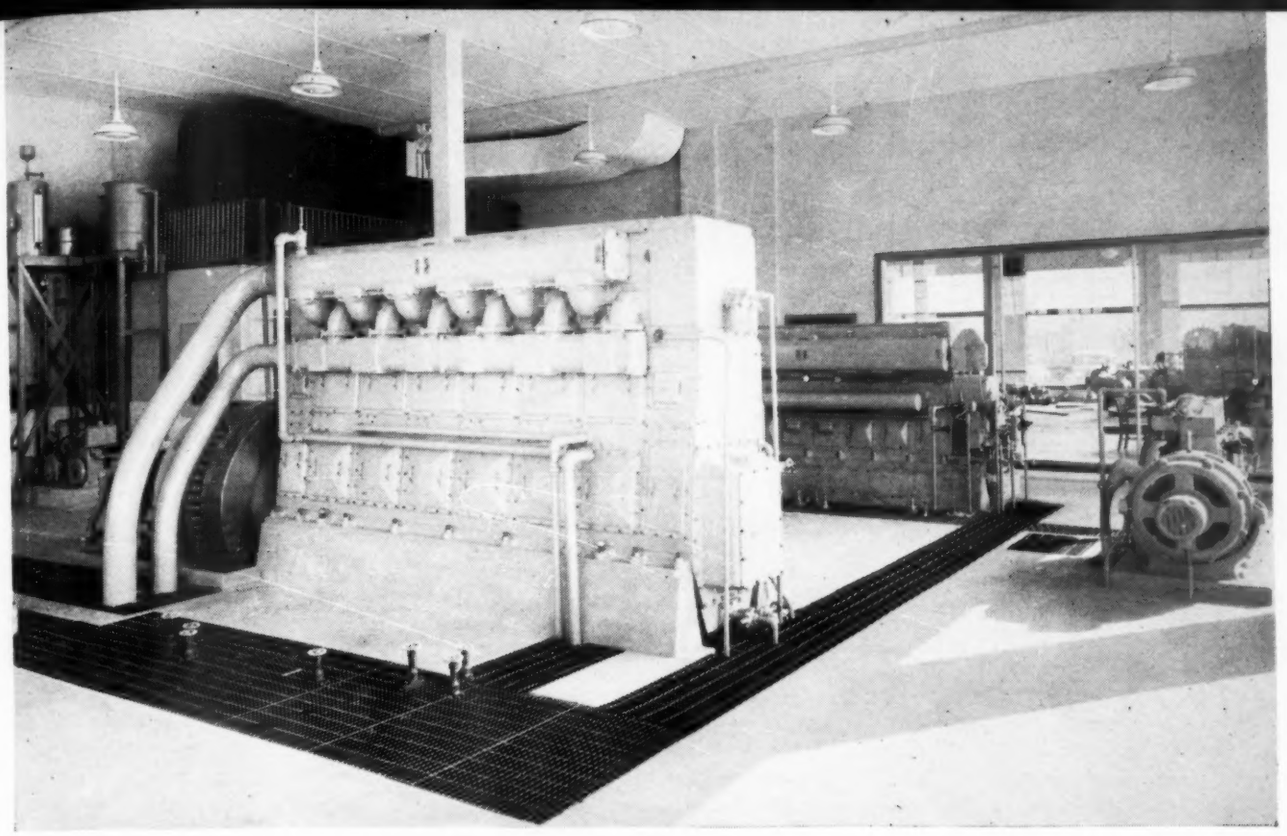
| | | |
|---|---|---|
| Specific gravity of mud | 1.22 | |
| Weight of mud | 11.8 | lb./gal. |
| Viscosity | 62 | seconds |
| Gelling | Good | |
| Settling | Good | |

This final report indicated the condition of the mud to be fair and efforts were made to maintain this weight and viscosity for the remainder of the drilling in this formation.

Continued experimentation is being carried on and the near future should see much accomplished in this field of mud treating. In view of the fact that as wells are drilled deeper the problem becomes more complicated, it is very probable that new equipment for handling and testing mud will be developed.

**Sinclair Oil Exhibit at Texas Centennial**





A 300-hp. Diesel with common rail system of fuel injection direct-connected to an a-c generator; a 330 h-p. Diesel direct-connected to an a-c. generator, the engine having separate fuel pumps for each cylinder; a 4-cylinder, 1200-r.p.m., high-speed generator set.

# Principles and Development of the Diesel Engine

**¶ The Diesel of the Present-Day Has Developed from Simple Fundamental Principles, the Application of Which Results in High Thermal Efficiency and Economical Generation of Power**

PRESENT-DAY Diesel engines in oil field service embody many refinements of the operating principle developed primarily by Dr. Rudolph Diesel in 1892. The "Diesel" is popularly regarded as of recent development, when, as a matter of fact, it has been under development practically as long as the gas engine.

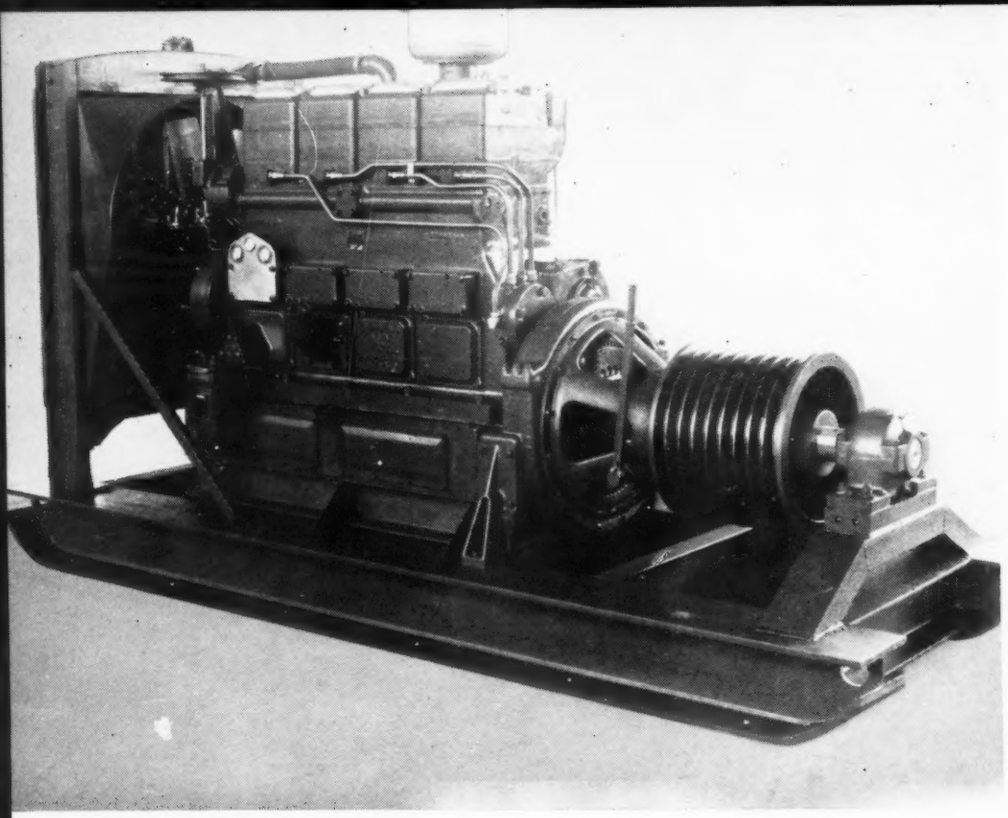
The Diesel is an internal combustion engine designed very similar to the present-day automobile engine with which every one is familiar. In order to make use of the Diesel principle, that of high-compression ratio, the Diesel must be of much heavier and sturdier construction. It has no carburetor, spark plugs, or electrical ignition system. Like the gas engine, most Diesel engines operate on either the four-stroke or the two-stroke cycle principle.

On the down stroke, or the admission stroke of the four-cycle engine, the intake valve opens and pure air is drawn into the cylinder through the intake manifold. On the second or compression stroke, with both the intake and exhaust valves closed, the air is compressed to practically 500 lb. per sq. in. in the combustion chamber. The heat of compression raises the temperature of this air to approximately 1000 to 1100 deg. fahrenheit. Just before the piston reaches the top of the compression stroke, the injection valve opens, admitting a charge of fuel that is finely atomized by the action of the spray nozzle in the injection valve. This fuel enters the com-


• Orville Adams, Diesel engineer and author of the group of articles on this and succeeding pages, has written extensively for leading technical journals, and is the author of textbooks on the Diesel used in schools and colleges. He has devoted more than ten years to the study of the Diesel engine and its development, and has made exhaustive researches on the subject. His experience, which also includes sales and service engineering with leading Diesel engine manufacturers, has given him a practical as well as a technical viewpoint.

• In these articles he deals with the broader aspects of the application of the Diesel engine to the petroleum industry, and also discusses problems of maintenance and operation.

ORVILLE ADAMS



A Diesel engine of the type adapted for many uses in the oilfield

pressed air, whose temperature in the cylinder is much higher than the ignition point of the fuel oil, and combustion takes place automatically without the use of the spark plug or other ignition devices. The rate of injection of fuel into the combustion chamber is so regulated that ignition and complete combustion take place without explosive force, producing a prolonged working stroke of constant pressure similar to the steam engine. On the last stroke the exhaust valve opens and the piston expels the burned gases to the air and completes the cycle.

The two-cycle Diesel engine is similar in operation except that the complete cycle occurs in one revolution of the crankshaft and two strokes of the piston instead of four.

### Efficiency of the Diesel Engine

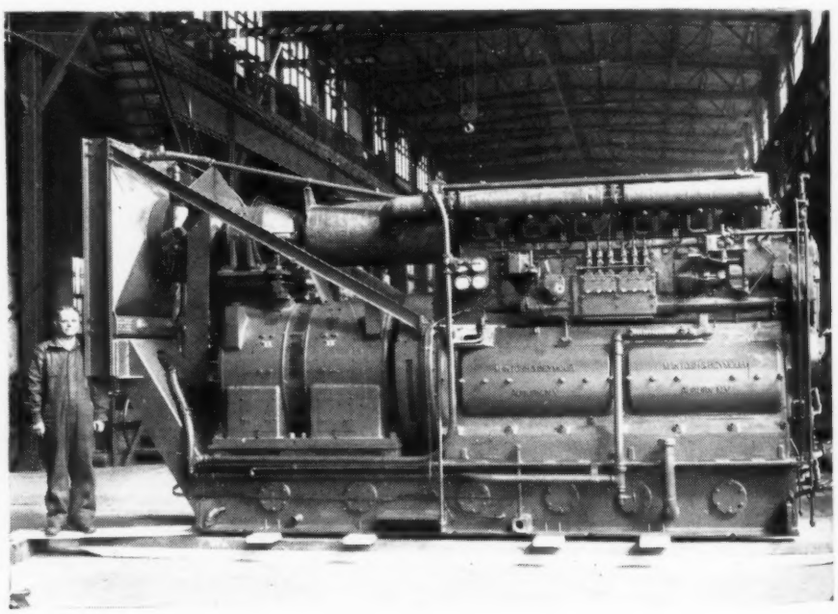
The Diesel engine is an economical source of power because of its high thermal efficiency may be raised to 60 low-priced fuel oil. By thermal efficiency is meant the percentage of potential energy contained in the fuel that actually is converted into power. The modern Diesel engine operates at a thermal efficiency of between 30 and 37 percent. There are only two important sources of heat losses, the exhaust gases and the cylinder cooling water. By recovering waste heat the thermal efficiency when operating on

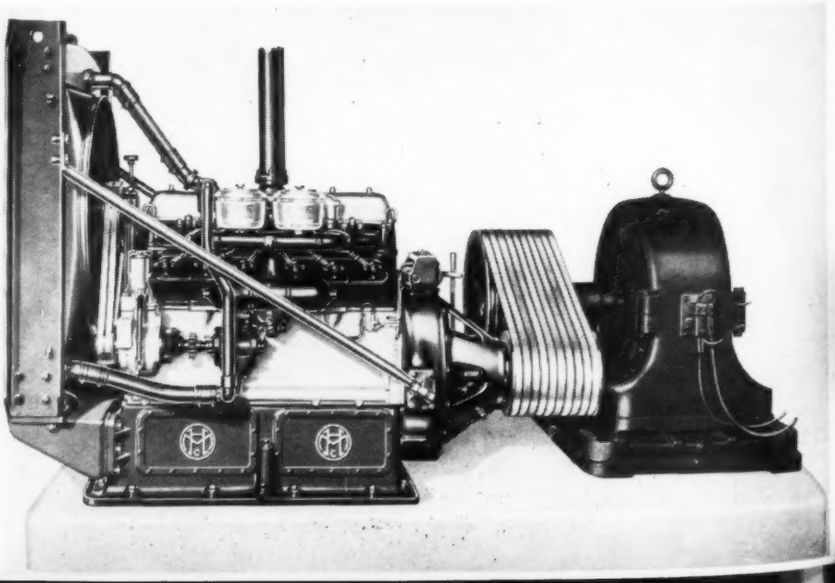
Modern Diesel engine driving an electric generator through the V-belt drive

percent. The heat of the exhaust gases and the cooling water, which is usually dissipated, can be utilized by feeding the hot jacket water into a waste heat boiler fired by exhaust gases. The hot water also is utilized in heating systems and for preheating fuel oil. In the Diesel there will be approximately 58 percent waste heat, 30 percent being dissipated in the cooling water and 28 percent in the exhaust gases. Of the 42 percent that goes into indicated horsepower seven percent will be absorbed by engine friction, leaving 35 percent for effective horsepower.

The Diesel engine need be only large enough for immediate needs, as additional units may be added when needed. Multiple units can be operated with the same economy as a single unit.

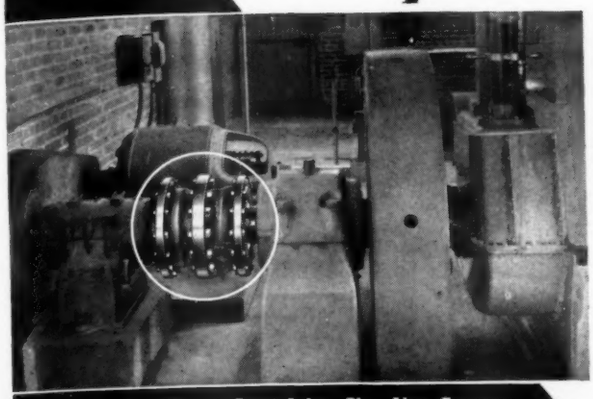
Below—A 300-hp., 6-cylinder Diesel unit, complete with generators, radiators, etc., suitable for driving a drilling rig



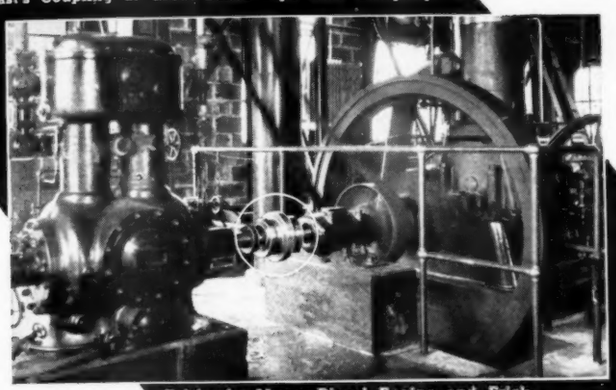


# *Experience has made*

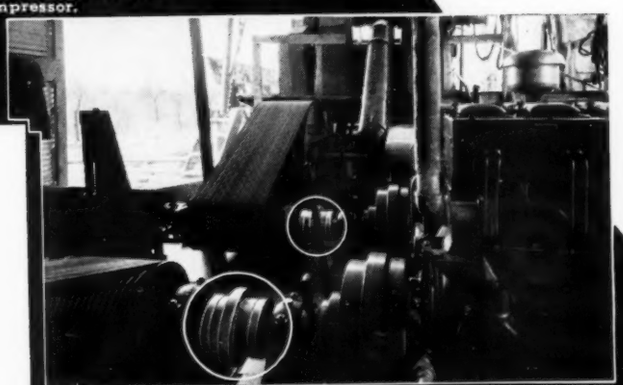
# FAST'S SELF-ALIGNING COUPLINGS *the choice of* DIESEL ENGINE *manufacturers*



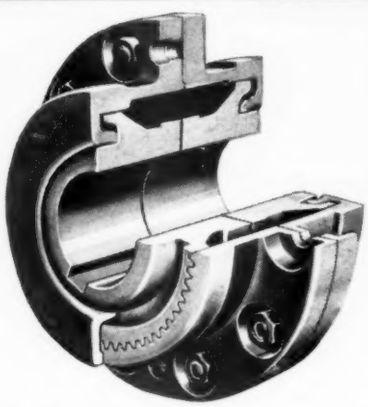
Fast's Coupling at Great Lakes Pipe Line Company.



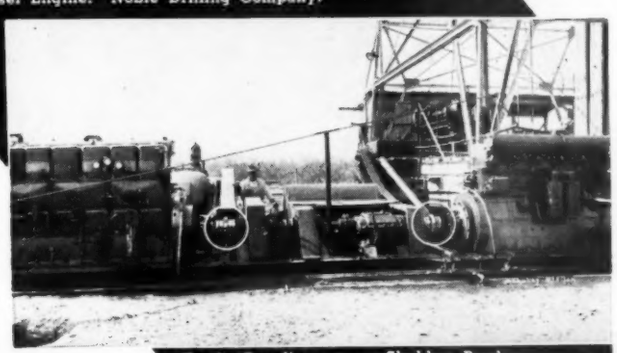
Fairbanks Morse Diesel Engine and Frick Ammonia Compressor.



Cummins Diesel Engine. Noble Drilling Company.

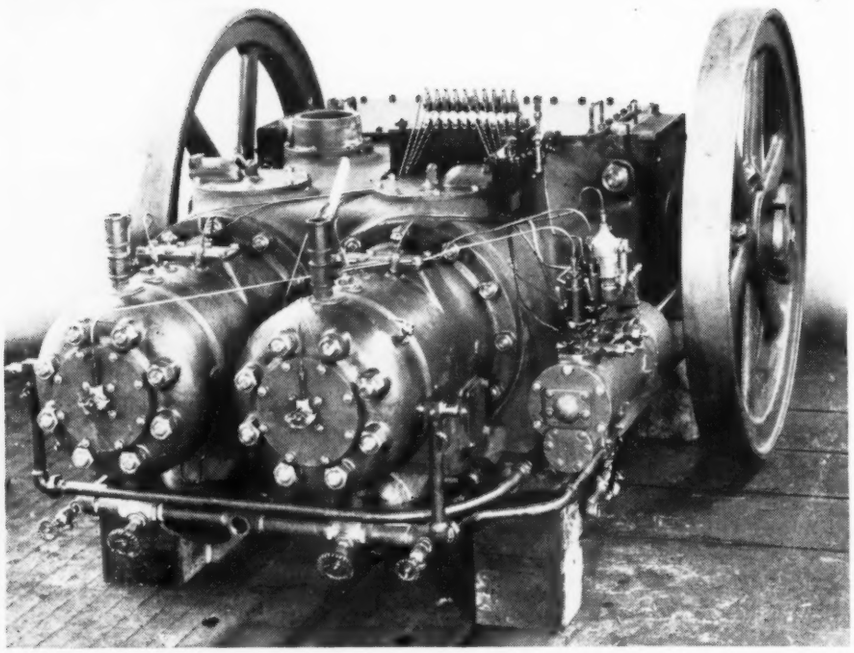


THE illustration above shows Fast's construction. The load-carrying surfaces are protected from wear by a positive film of oil. This oil is kept permanently clean by the rocking bearings which make precise metal-to-metal contact forming permanent dust and moisture proof seals. These vital features are covered by Fast's patents.



Fast's Couplings on a Sheldon Burden Drilling Rig.

KOPPERS COMPANY
BARTLETT HAYWARD DIVISION
BALTIMORE, MARYLAND



**Horizontal twin Diesel engine of recent design for well-drilling and other oilfield service**

### Construction and Operation

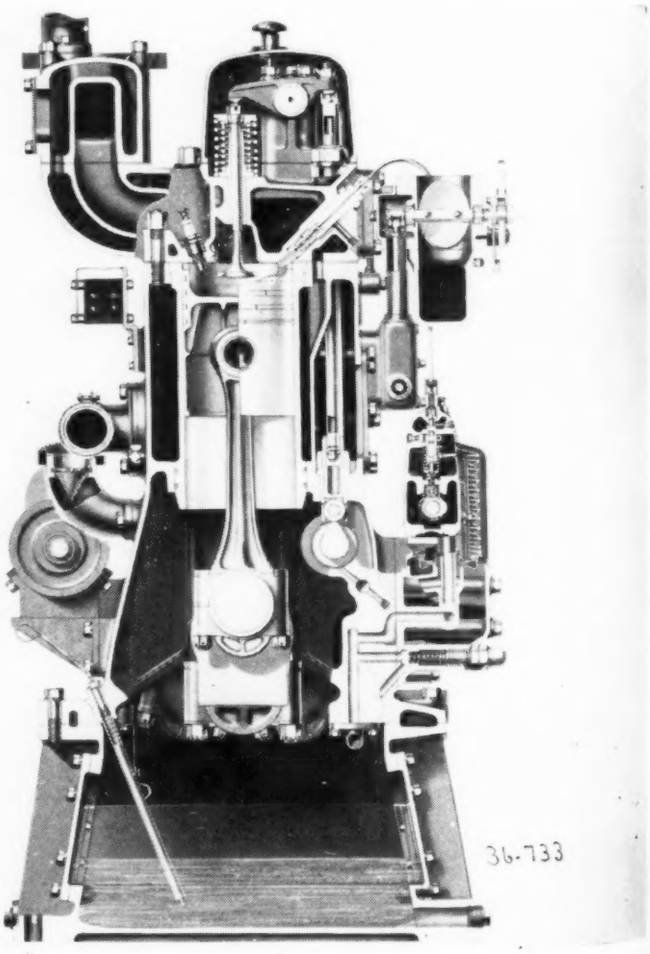
The Diesel engine is simple in operation and anyone who has the necessary mechanical ability to operate a gasoline motor will find little difficulty with the Diesel engine. The starting of the engine is quite simple, requiring only the manipulation of a single lever or throttle. Constant attention of the operator is not required. Simple safety devices to protect the engine against failure of the lubrication and the cooling-water system may be installed, giving absolute assurance against damage from these causes. Except in large units, and multiple unit installations where the variation in the load on the plant requires frequent stopping and starting of the units, an operator is not required to be in constant attendance.

### Maintenance Costs

Reliable records disclose that the annual cost of replacement parts for Diesel engines is less than two percent of the original cost of the engine. The maintenance cost of the Diesel engine should not be confused in any sense with similar costs for average high-speed internal combustion engines. Diesel engines usually found in oilfield service are rugged in construction. Ample bearing surfaces insure the wear being distributed over a great many years, and replacement of major parts infrequent. The life of such engines is conservatively estimated to be from 15 to 20 years, with a reasonable cost for upkeep. Many engines in pumping service for 15 years or more are still giving good service in the field of oil pipe line transportation

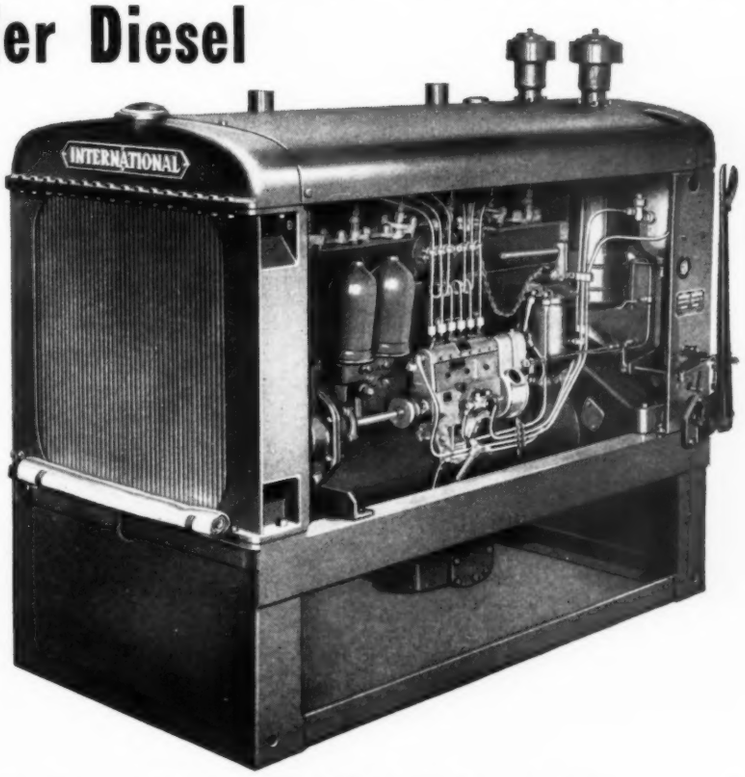
So closely does the overall efficiency of the Diesel engine approach theoretical perfection that there has been little possibility of further reduction in fuel consumption. Despite all the refinements and developments of the last quarter of a century, the economy of the Diesel engine has remained practically constant during that time; hence obsolescence is not likely to be such an important factor in the Diesel engine. Improvements in recent years have been confined mainly to balanced design and refinement of auxiliaries. Any improvement in efficiency in the future undoubtedly will be made in the direction of using better materials, more protection for engine-cooling and lubricating systems, and the adaptability to different speeds and applications.

Men in the operating branches of the oil industry will be interested in the important elements of Diesel application and operation and what is




**Sectional view of the Hesselman engine showing the spark-ignition and fuel-injection system**

# The New International PD-80 Power Unit —the Only 6-Cylinder Diesel That Can Be Cranked by Hand




With the introduction of the new Model PD-80 Diesel Power Unit, the valuable features of International Harvester Diesel Engine design have become available to many new users of heavy-duty power in the oil industry. This big 6-cylinder engine, with its 4¾-in. bore and 6½-in. stroke, develops a maximum of 100 h.p. at 1400 r.p.m. and delivers 80 h.p. under continuous load.

The new International PD-80 starts as a conventional gasoline engine and is as easy to crank as any gasoline engine of its size. It is the latest addition to the International line of power units ranging in size from 12 h.p. to more than 100 h.p., including the Model PD-40 Diesel which has a maximum of 62.5 h.p. at 1250 r.p.m.

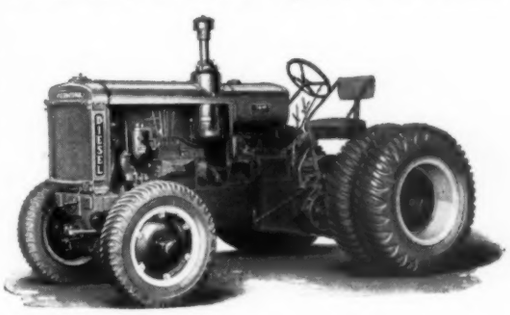
*International Model TD-40 Diesel TracTracTor owned by Earl Collins, Riverdale, Kans., digging a slush pit.*

## International TD-40 TracTracTor

This International Diesel-powered crawler tractor makes low costs a reality on heavy-duty work. Combined with its economical operation is its maintenance economy—International TracTracTors are the most accessible crawler tractors on the market. The Model TD-40 has thoroughly proved its abilities under all kinds of operating conditions everywhere.

## America's FIRST Diesel-Powered Industrial Wheel Tractor— the new INTERNATIONAL ID-40

International Harvester, world's largest tractor builder, scores another *first* with the new Model ID-40. This organization has adapted the Diesel principle to wheel-tractor operation, the first time it has been done in America. This new tractor uses the same International Diesel engine that has proved so successful in the International TD-40 TracTracTor and the Model PD-40 Power Unit. The Model ID-40 Tractor has power and stamina to handle a variety of heavy-duty work calling for a wheel tractor. Investigate it and the full line of International Industrial Power.



**INTERNATIONAL HARVESTER COMPANY**
(*Incorporated*)
606 So. Michigan Ave. Chicago, Illinois

**INTERNATIONAL HARVESTER**

**Diesel tractor cutting a road through a rough stretch of land. Such equipment provides economical power for a variety of construction and maintenance jobs in the oilfields, around refineries, and on pipe line projects**

required from a maintenance standpoint when a Diesel is to be used in oilfield service.

Recent developments in adapting the working parts of the Diesel engine for use in high-speed applications have been directed toward removing natural handicaps. Another problem, now virtually solved, has been that of cold starting. Though it is still a problem, several arrangements that overcome it are in general use. Storage batteries and electric-starting for high-speed engines, air-starting for the slow- and medium-speed, still obtain. The use of heating plugs to facilitate starting is now accepted practice. Gasoline engine cranking systems have been developed for heavy field engines, for starting on tractors, and for rugged industrial and contractors' equipment. Some form of heating plug or incandescent punk inserted in the combustion chamber of one or two cylinders is required for starting certain engines in cold weather. Arrangement of the engine to operate as a gasoline engine while starting is another solution of this problem.

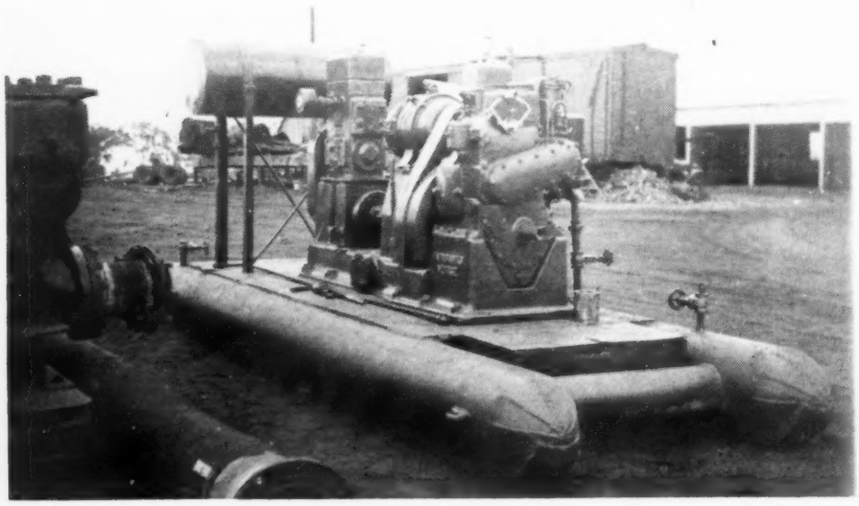
Effective methods of filtering the lubricating oil are being constantly developed, along with similar methods to insure clean fuel entering the injection system. From a maintenance standpoint, the chief requirement of a fuel filtering system is that it should be effective as well as practical. Present day engines must have efficient filters or strainers on the fuel system, for lubrication by pressure methods require a continuous filtering system. No high-speed engines today are installed without such auxiliaries.

Methods and designs assuring thorough lubrication of the timing gears, as well as valve-stem lubrication, are features of the latest engines now in service. Many lubrication problems that affected the maintenance and operation of the early Diesel engine have been solved. Valve-stem and timing-gear lubrication was at one time a serious problem; today, there is little difficulty in this respect.

Replaceable liners, or cylinder sleeves, have come into use with the demand for reduced maintenance and longer life of the piston and cylinder. Modern Diesel engines usually are designed for easy replacement of the liners or cylinders. These liners are in many instances extra hard, being made of special metal alloys that resist wear and more than double the life of the liner.

The problems of piston design and heat have been the chief concern of the designer of the latest Diesel engines. Difficulties experienced with heat in the piston show that cast-iron pistons in high-speed engines suffer from scalding and cracking under the rapidly reoccuring high-temperature blows of Diesel combustion. Aluminum-alloy light-weight pistons have been developed to meet this problem. It used to be that the high temperature of the heat cycle of the Diesel engine and the high mean temperatures of the piston would eventually breakdown the average grade lubricating oil in field service, causing the rings to stick and rapid wear of the cylinder. Heat problems of this nature are being solved by research on the design of combustion systems that will assure lower operating temperatures in the cylinder. The high temperature of the piston and resultant heat problem are influenced to a great extent by the particular system of combustion employed and the design of the engine itself.

Diesel engines of the immediate future will embody improvements still in the process of development that will result in more reliable operation and further reduction in maintenance cost.



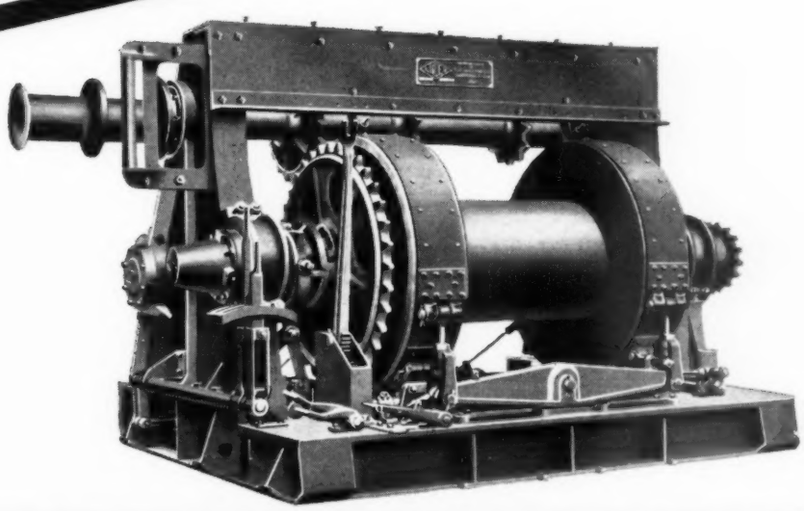
**Combination air-starting and lighting unit, used on drilling rigs**

**...A VOTE FOR AMERICAN ROLLER BEARINGS IS A VOTE FOR PERFECT BEARING PERFORMANCE**

NATION-WIDE POLL of manufacturers of heavy-duty drilling equipment shows that American Roller Bearings dominate!

PLATFORM: American Heavy-Duty Roller Bearings will stabilize your drilling dollar! They stand up under the most severe strains and loads of heavy-duty drilling.

CAST YOUR BALLOT for American Roller Bearings and balance your oil-well budget!



Latest Wheland-Lucey Draw Works. Thirty other famous manufacturers of heavy-duty drilling equipment vote "American"—and not one application has ever "taken a walk"!

**AMERICAN ROLLER BEARING CO., PITTSBURGH, PA.**

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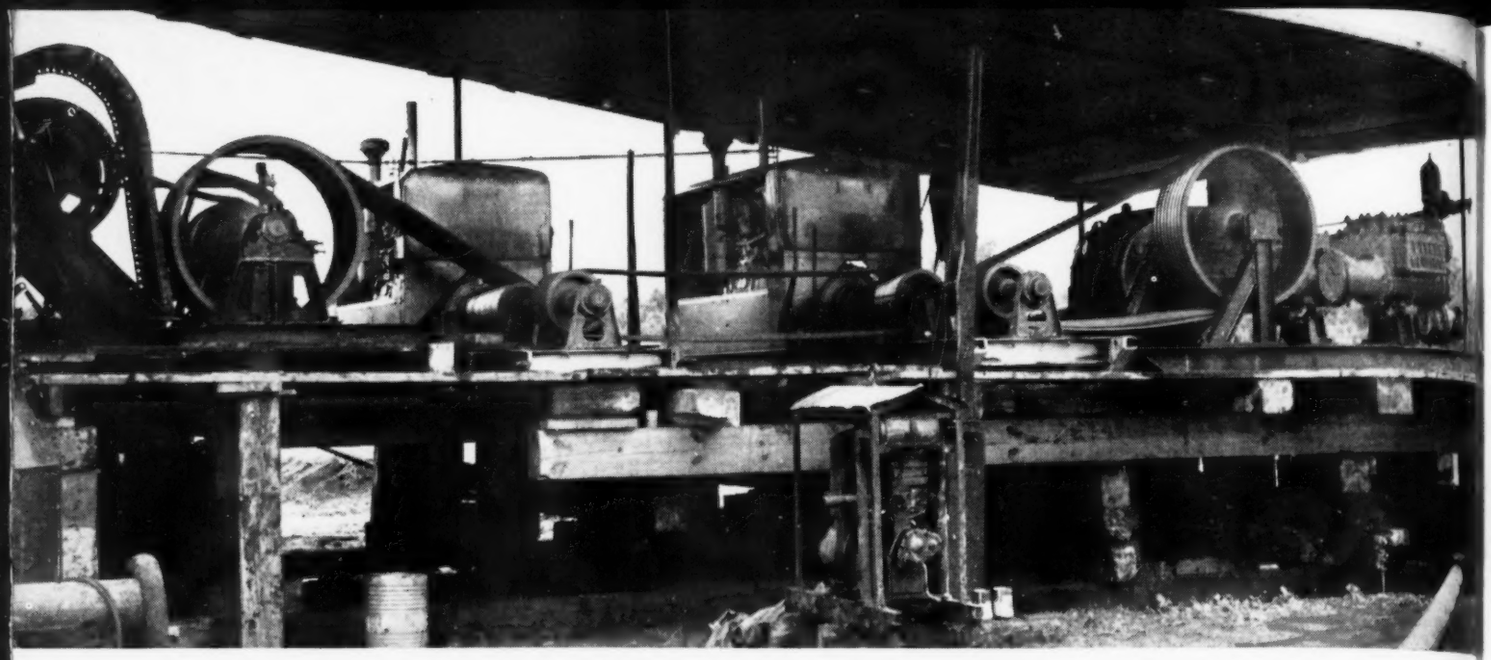


Fig. 1. Two high-speed Diesel units equipped with special clutch shafts and extended bases, operating a rotary drilling rig in Texas

# Diesel Power In Drilling Practice

## Low Fuel Cost and Water Consumption Have Been Important Factors Contributing to Rapidly Increasing Use of Diesel Power for Drilling

ALTHOUGH the drilling of oil wells with Diesel power was pioneered a comparatively short time ago, hundreds of wells already have been completed with this type of prime mover. Because of their low fuel and water consumption, Diesels were found to fill a need at isolated wildcat locations where good water was scarce and the delivery of suitable fuel costly. It was thus that the Diesel was introduced for heavy rotary drilling.

Now that the Diesel engine occupies an increasingly prominent place in drilling operations, it seems opportune to present some important facts concerning Diesels that will be found of value to those interested in their operation, maintenance, and economy in this severe type of service.

### Availability and Portability

Diesel engines now available for this service range in horsepower and weight from light high-speed units of 120-150 hp. to the larger heavy-duty type weighing ten tons each and developing 300 to 400 horsepower. Regardless of their hp. rating, almost all Diesels used in drilling service are readily adaptable to transportation by truck. They can be loaded on trucks completely assembled and usually do not require any dismantling for transportation to location. Very often the engines, auxiliaries, and a supply of fuel and oil sufficient for a week can be delivered at the well in one truckload. When more than 200 hp. is required and portability is most essential, the engines are used in tandem or in multiple units of available portable units. Time being of the essence in most drilling contracts, the Diesel rig used for drilling can, with reasonable dispatch, be put in full operation within a few hours after arrival on location.

### Cost of Operation

The operating economy of the Diesel rig can be best demonstrated by a specific illustration. One of the earlier rigs placed in service, using a 120-hp. Diesel engine, when running at full load under average drilling conditions consumed 60 gal. of fuel oil and one and a half gal. of lubricating oil per day. Assuming the oil, delivered to the well, costs five cents a gal., and the lubricating oil 62½ cents a gal., operation of the engine costs $3.95 per day.

Cooling water for the Diesel is not a serious problem. As the amount of evaporation is very small the water used for drilling usually can be supplied to the Diesel radiator.

### Flexibility of Operation

Its wide range of flexibility makes the Diesel engine especially adaptable to modern drilling operations A typical high-speed unit, normally operating at full speed of 650 r.p.m., may be throttled down to 150 r.p.m., and within a few seconds can be accelerated to 650 r.p.m. Due to its high torque, its lugging characteristics are such that at low speeds a heavy string of casing, drill pipe, or tools can be picked up with ease and pulled from the hole with the desired speed. The Diesel engine actually develops an increasing torque as the speed is reduced, and under a heavy load its lugging characteristics are brought into play. Controls are operated from the jack post by remote control device to the throttle, making the speed range flexible and instantly responsive to the touch of the driller.

### Convertible Diesel-Gas Engines

Of the Diesel engines used in drilling service, some are convertible to operate on natural gas by the addition of a special combustion chamber, gas-mixing valve, and an electrical ignition system. The construction details and the operation of convertible Diesel-gas engines are shown in accompanying illustrations.

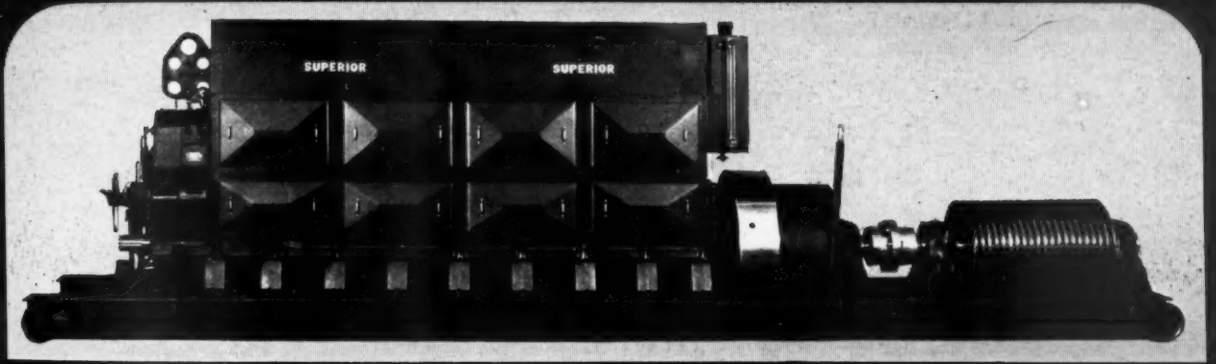
### Application of Diesels to Drilling Rigs

It must not be supposed that the application of the Diesel engine to oil-field service was made without encountering problems of a serious nature. There were difficulties to overcome from the outset. Only in the last two or three years has progress been made toward eliminating problems associated with the heavier engines, such as the slow speed and non-portability that required heavy concrete foundations, time to install, and difficulties in obtaining reliable operation. None of these difficulties was insurmountable. After the engine and machinery builders became familiar with rotary drilling and other oil field power problems, rapid progress was made. Specially designed Diesel drilling engines have been put in service by

# Superior DIESELS for DRILLING SERVICE

A complete line of drilling engines ranging from 50 to 350 horsepower that meets the power needs of every contractor on wells from 2000 feet to 12,000 feet in any territory.

Dependable and economical operation, flexible, wide speed range have established Superiors as the most efficient of prime movers.

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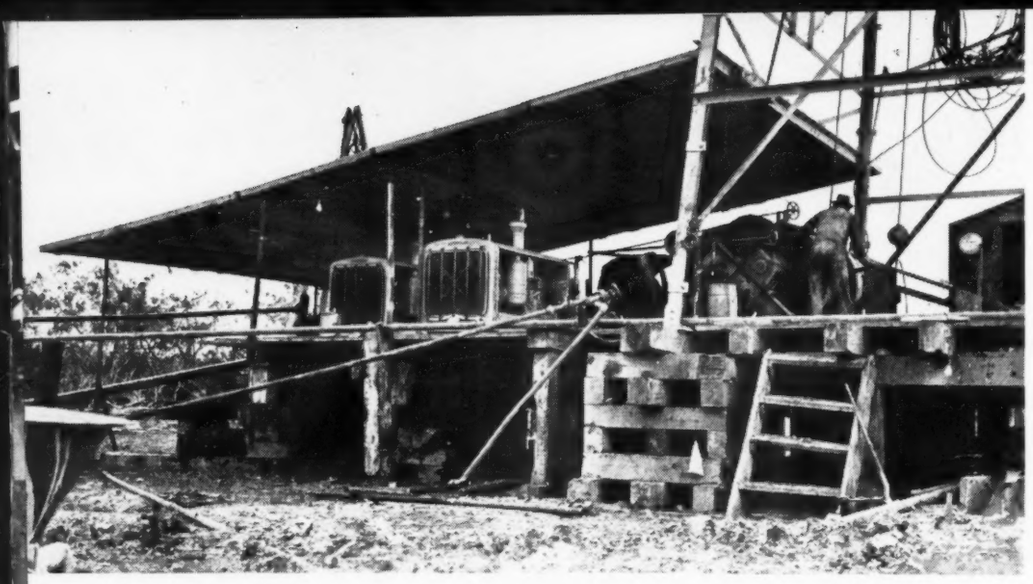


**Fig. I-A. High-speed Diesel units operating a rotary drilling rig, and arranged for compounding for hoisting**

several engine manufacturers during the last two or three years and included a number of models from 100 to 400 hp., with speeds from 300 to 1200 r.p.m. Such engines are now being used in several fields.

At the very outset, it was obvious that Diesel engines of special design were needed to meet the varied requirements of modern oilwell drilling service. During the last 12 months, the number of Diesel-driven rigs has increased rapidly. Diesel mechanical-driven rigs of various types are in use on drilling locations throughout Oklahoma, Kansas, Texas, and New Mexico. Methods of connecting Diesel engines to the drawworks and slush pumps are quite varied. Many arrangements have been tried to suit the various sizes and speeds of engines. Though developed from experience in the field, good engineering is in evidence in the modern type drive. Various arrangements and details of the various types of transmissions are shown in accompanying diagrams.

The most typical and popular method involves the use of two engines of the same rated horsepower and speed, of the convertible type. Speeds vary from 200 to 600 r.p.m.; on light rigs sometimes higher speeds are used. The usual method of connecting the engines through V-belt, chain, or gear box to the slush pumps and drawworks is quite generally followed. The main transmission is so arranged that the power from either engine can be employed for the drawworks or pumps, or compounded for the hoisting operation. Engines are self-contained, with as much of the auxiliary equipment as possible built-in, and the units mounted on heavy H-beams to facilitate their transportation by truck. It is desirable that the weight be kept within reasonable limits. The larger units of 400 hp. weigh as much as 25,000 to 30,000 lb. each and are as heavy as is usually found in this service.

Reflection will reveal that the Diesel mechanical drive suitable for drilling presents many problems not confronted in electric or similar drives such as found in other service where engines may operate at constant speed and torque. The wide range of speeds and fluctuations of load required in drilling demand engines possessing considerable flexibility of control. This necessitated the development of fuel and governing systems in such combinations that perfect combustion and the equal distribution of the load under all conditions could be obtained by meeting instantly the variations in load and speed. Governors likewise were developed to respond to the instantaneous and wide variations in load by remote control from the driller's position, the control acting directly on the fuel system.

The horsepower required for wells of different depth is a basic factor and has to be determined for the given

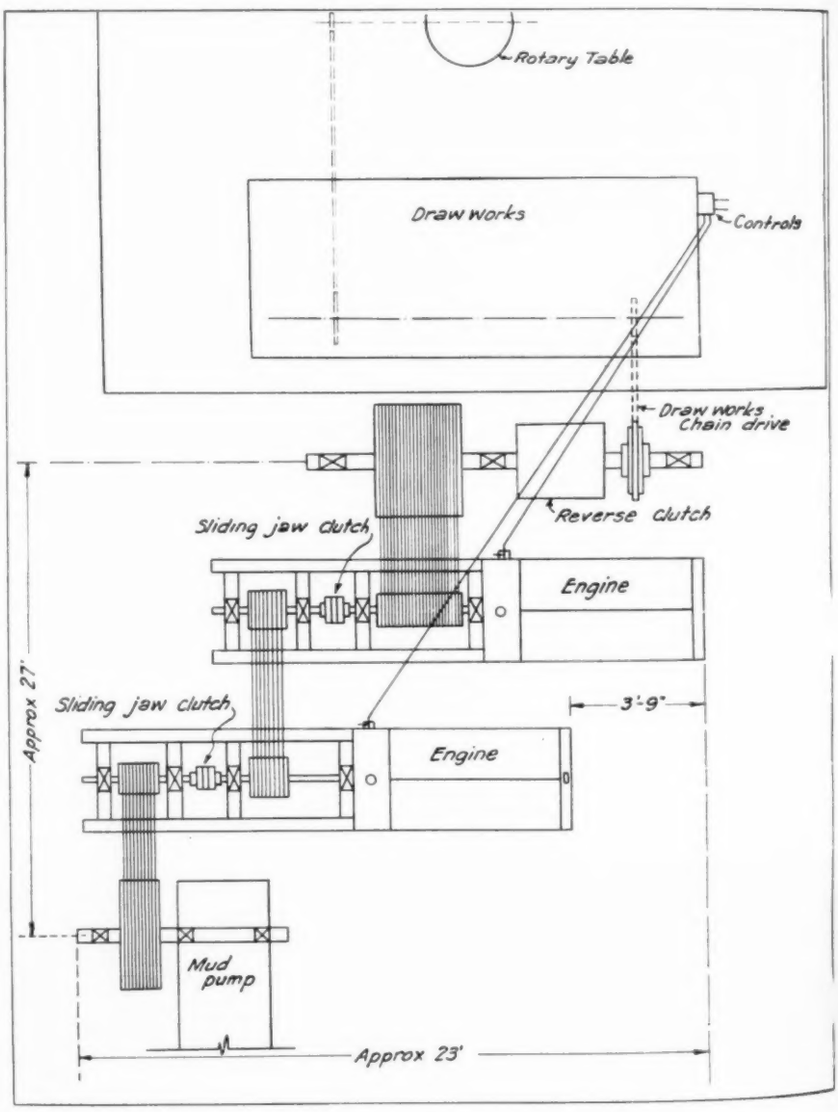



**Fig. 2. Arrangement of V-belt drives on Diesel-driven rotary drilling rigs. With the hook-up shown here it is possible to operate the motors together or individually**

# 5 Carloads OF CUMMINS DIESELS FOR THE OIL FIELDS

● **Dependability proved** . . . by thousands of h. p. hours of continuous day and night service.

● **Cold starting** in any kind of weather.

● **Light weight** . . . easily transported from one job to another.

● **Flexibility** . . . instant acceleration at a touch of the throttle.

● **Smooth running** from idling to full load.

● **Adaptability** to wild cat drilling . . . less than a quart of water a day per engine.

These are the reasons experienced drillers turn to Cummins Diesels. This is why five carloads of Cummins Diesels have gone into the oil fields the first six months of this year.

## CUMMINS DIESELS

CUMMINS ENGINE CO., 1600 WILSON ST., COLUMBUS, IND.

conditions. Deep holes require heavy rigs and hence considerable investment in surface machinery. This has led to adoption of the practice of arranging engines and rigs so they can be compounded for hoisting in deep well work.

For cable tool and light rotary drilling several high-speed units have been devised. In Figs. 1 and 1-A are shown a unit of this type that is arranged for compounding for hoisting. In Figs. 2, 3, and 4, are shown the arrangement of V-belt drives on Diesel-driven rotary drilling rigs. With the arrangement shown in Fig. 2 it is possible to operate the motors together or individually. When operating together, the jaw-clutch on the drawworks engine is engaged, thus permitting the power of both engines to be transmitted through the main drive to the reverse clutch. When operating individually, the jaw-clutch on the drawworks engine is disengaged and the pump engine clutch is engaged, thus allowing the compound of engine-to-engine drive to run idle. The installations are equipped with V-belt drives throughout and are very satisfactory. The main drive consists of 20 D-section ropes, the engine-to-engine drive of eight D-section ropes, and the pump drive of 12 D-section ropes.

Fig. 3 shows an installation for a V-belt drive of an improved type used on rotary wells in Southwest Texas. It will be noted that this layout is not necessarily restricted to V-belts, as it readily can be seen that high-speed roller chains also are adapted to this drive, or can be substituted for any or all drives. Many engines are so arranged, particularly those employing the light-weight, high-speed engines of moderate ratings.

Fig. 4 shows a slight modification sometimes used instead of the drive shown in Fig. 3, and has certain advantages. In this design the jaw-clutches have been replaced with friction clutches and the over-hanging drive is eliminated. This, of course, will necessitate approximately a 5-in. shaft turned down on the ends to fit a 15/16-in. roller bearing. Drives of this type are used only with a unitized drawworks or a transmission to replace the reverse clutch. As is seen on the drawings, the governor controls are carried through a series of linkages, universal joints, and water pipes to a common point at the driller's stand, where there is a control box whereby the governor controls for both engines may be handled by one lever or may be operated separately with individual levers. This method gives a rigid control and eliminates all possibility of the engines getting out of synchronism when compounding for hoisting. A rig of this type using two 125-hp. engines is satisfactory for drilling to a depth as great as 5000 ft., using a 4-in. drill stem and four to six lines. By using eight lines and a well-designed drawworks, such an installation has been used to drill to a depth of 5500 feet.

Experience indicates that fuel consumption ranges from 1000 to 1200 gal. for a 4000-ft. or 4500-ft. hole, depending, of course, on the formations encountered and skill in handling the rig.

## Application of Two-Cycle Horizontal Oil Engines

Generally speaking, the type of Diesel engines used for drilling rigs up to two years ago had been the multi-cylinder four-cycle high-speed light-weight engines driving the drawworks through some type of reversing mechanism, usually of the planetary reverse clutch type. The available horsepower made it desirable to have a transmission that would permit compounding of the pump and drawworks engine for hoisting. The compounding feature has become recognized as an essential complication by the contractors who have found by experience that such an arrangement in case of engine trouble was necessary if sufficient power was to be available to get out of the hole or maintain circulation.

An important requirement for rotary drilling is absolute dependability. As a result, there has been adapted to this service the well-known two-cycle, solid-injection, slow-speed horizontal engine, a great number having been placed in service in recent months. Such an engine is widely known for its sturdy, simple design with one or two cylinders, and simple port-scavenging construction. This de-

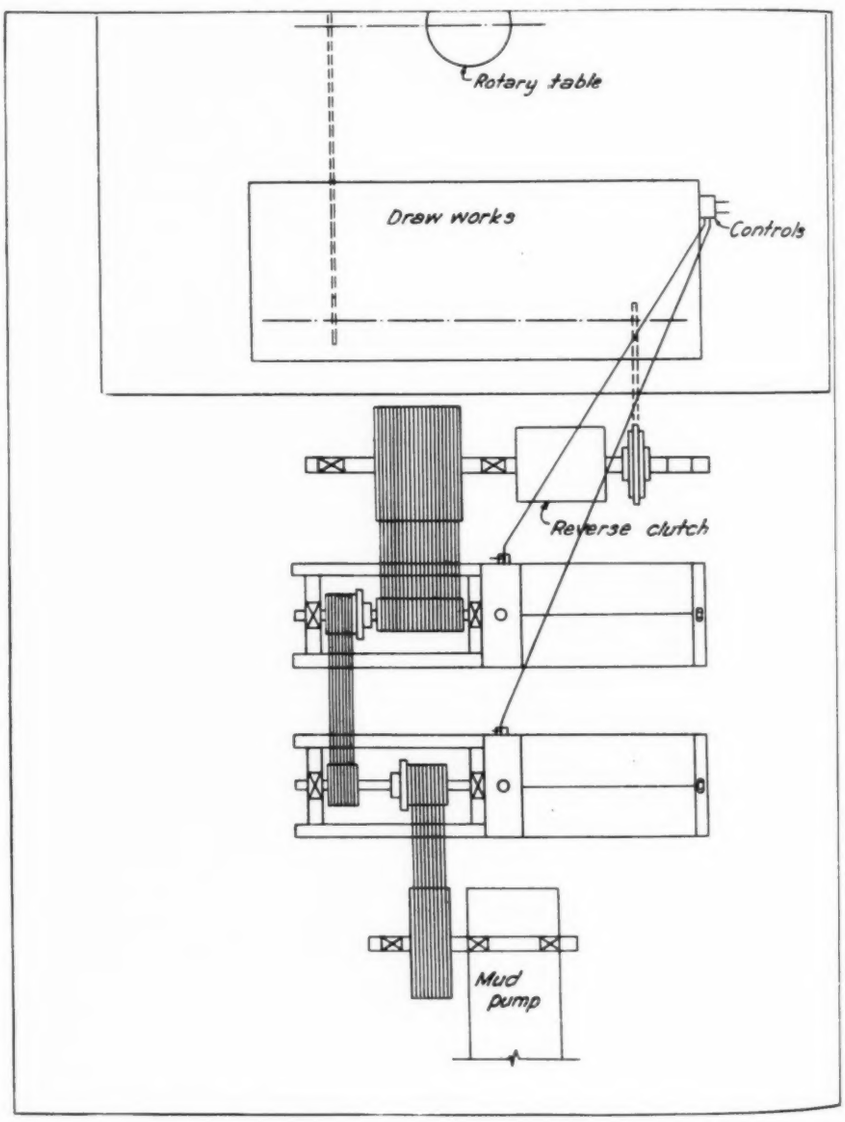
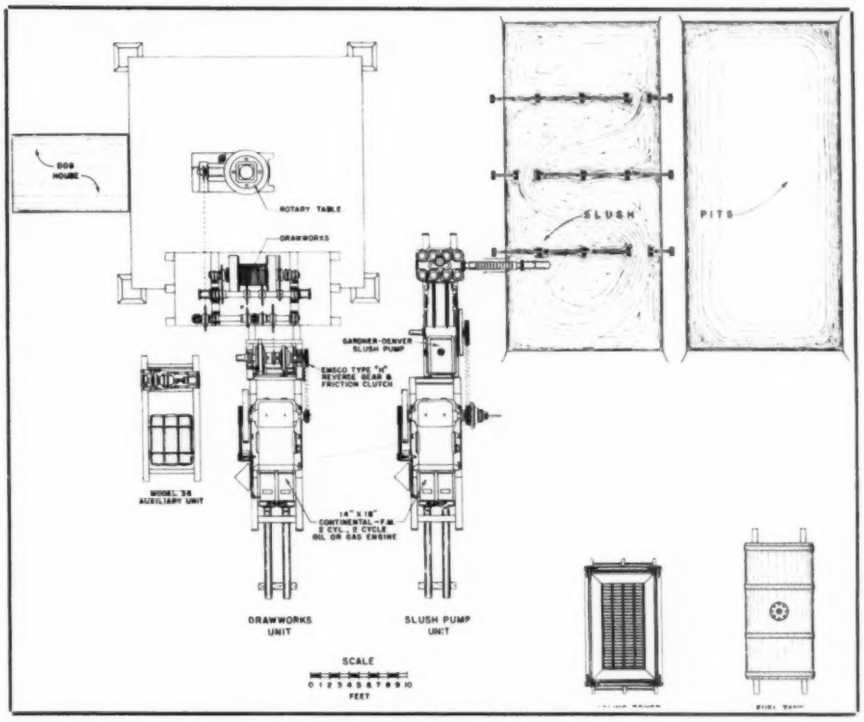



**Fig. 3. Installation for a V-belt drive of an improved type used on rotary rigs in Southwest Texas**

Fig. 5. Layout of twin Diesel engine, medium rotary drive




sign makes for simplicity, has few working parts and low first cost. The present-day lack of experienced and trained Diesel operators also made such an engine attractive, since it may be operated even by untrained men. A large number of these engines now are in service in cable tool and rotary work. Many improvements in mounting and transmission have resulted from the experience in pioneering this type of engine for rotary service. The drive usually comprises two assemblies, the drawworks unit and the slush pump unit, as shown in Fig. 5. It will be noted that the engine is mounted on a heavy rigid steel base extended to receive a reversing clutch mounted directly on this base, and the skids are further extended to go under the drawworks and butt against the derrick sill. By bolting the drawworks to this skid extension and attaching turn buckles from the clips provided to the derrick corner foundation, the entire assembly is as rigidly held as if it were a single unit with the drawworks. Exhaust connections are led to the edge of the base, to which are attached two lengths of pipe when the engine is placed in operation. The air is admitted to the cylinder through an air filter. The clutch used as standard with this particular unit is a reversing and friction clutch with heavy-duty twin-disc forward clutch and differential reverse. The ease with which this clutch is operated from forward to reverse is one of its features. With the operating lever attached to a standard reverse and throttle control fixed on the drawworks, the operation of the unit is such that drillers may make a round trip with minimum fatigue, using a manual control similar to that to which they have become accustomed when operating standard steam units.

Fig. 6 is a sketch of a layout showing the drawworks power unit, and also the method of control and installation features.

The slush pump power unit is mounted on a short steel base of similar design to the drawworks unit. As shown in Fig. 7, this base is provided with a bolting flange to which may be attached a slush pump. A heavy-duty Diamond "D" Dodge clutch is mounted on the engine crankshaft. An

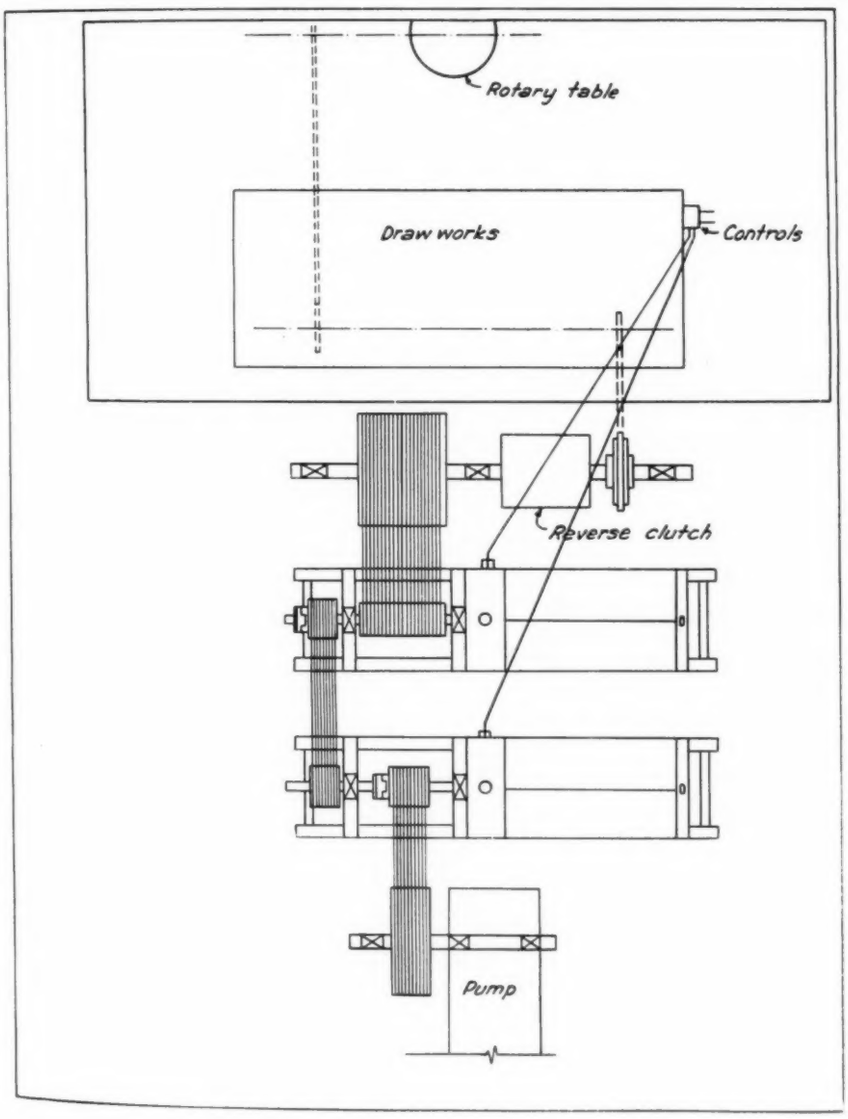



Fig. 4. Showing a slight modification sometimes used instead of the drive illustrated in Fig. 3

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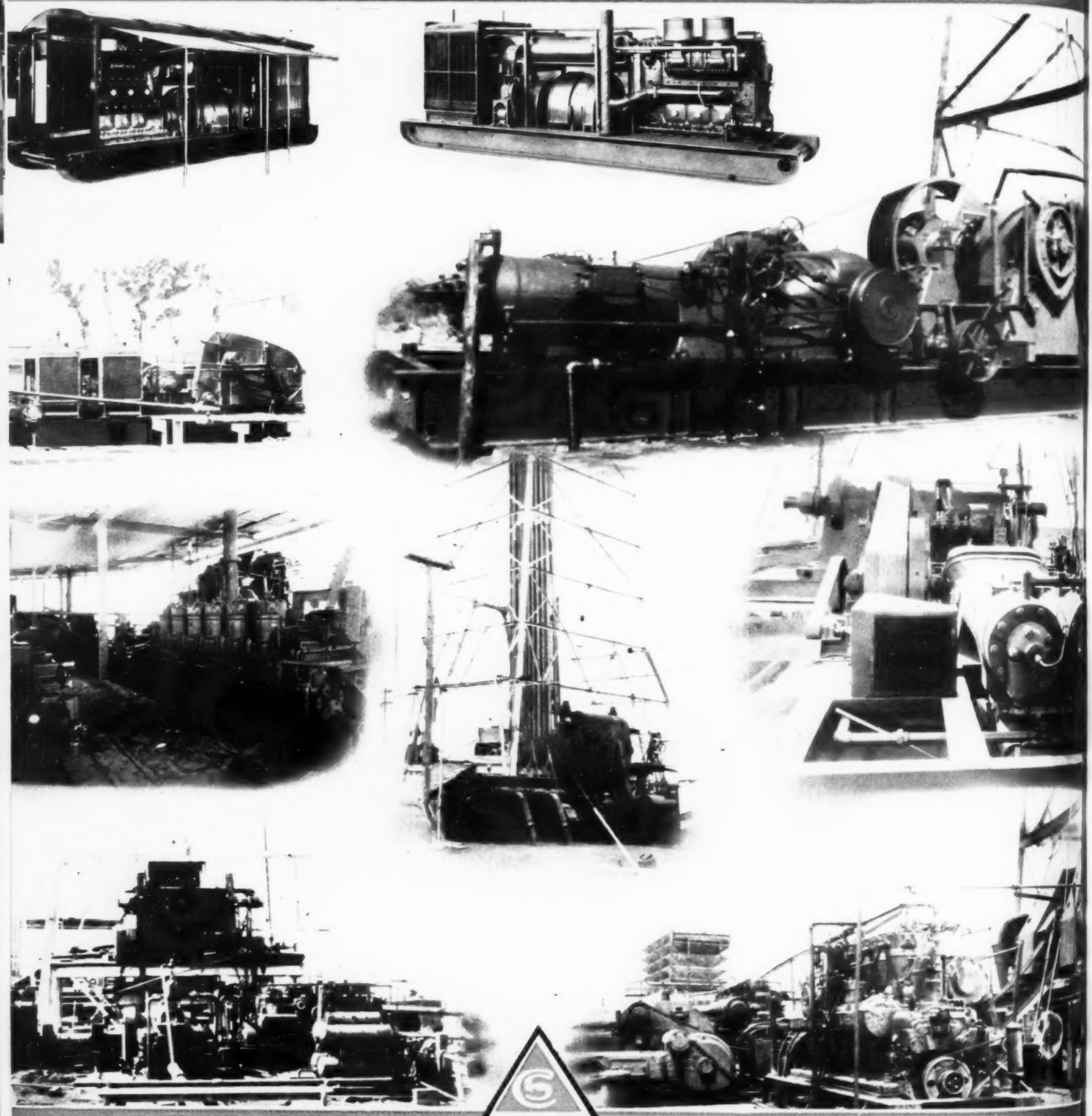

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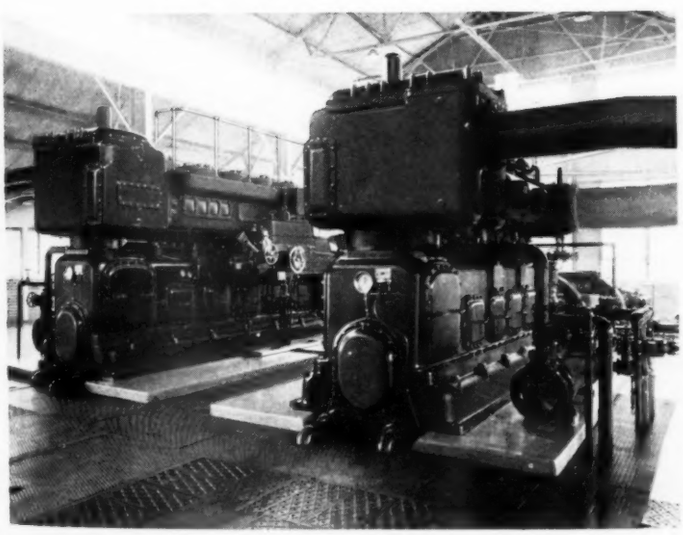
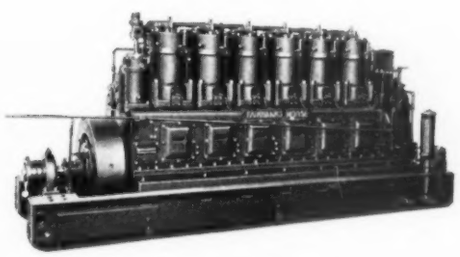
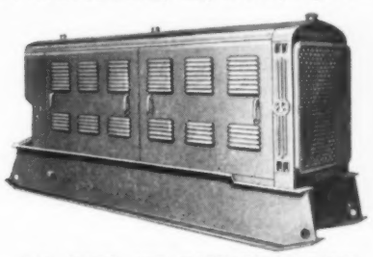


ON MAIN LINE DUTY
*Two 5-cylinder Model 33's, 16 x 20, 810-hp. F-M Diesels at work for Texas Empire Pipe Line Co. at Sour Lake, Texas.*



ON GATHERING LINES
*F-M Model 35—heavy duty Diesel for portable rigs*



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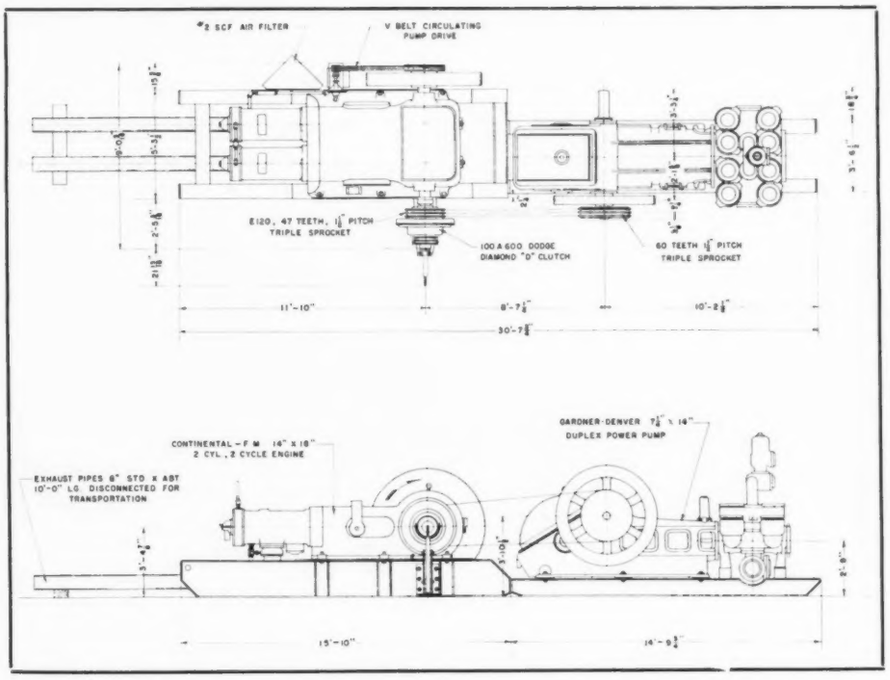

#2 SCF AIR FILTER
V BELT CIRCULATING PUMP DRIVE
E120, 47 TEETH, 1½" PITCH TRIPLE SPROCKET
100 A 600 DODGE DIAMOND "D" CLUTCH
60 TEETH 1½" PITCH TRIPLE SPROCKET
11'-10"
8'-7⅛"
10'-2⅛"
30'-7⅛"
GARDNER-DENVER 7¼" X 14" DUPLEX POWER PUMP
CONTINENTAL - F M 14" X 18" 2 CYL., 2 CYCLE ENGINE
EXHAUST PIPES 8" STD. x ABT 10'-0" LG. DISCONNECTED FOR TRANSPORTATION
15'-10"
14'-9½"

**Fig. 6. Sketch of a layout showing the drawworks power unit; also the method of control, and installation features**

outboard shifter is provided to disconnect the drive to the slush pump when this is desired.

### Horsepower Required for Hoisting

It is well known that the drawworks engine has two distinct duties to perform, rotating and hoisting. Many tests in the field have shown that the usual power requirements for table rotation will rarely exceed 120 hp., even for the deepest wells and for high rotational speeds, so that the depths recommeded for the engine in question leaves a considerable margin of reserve power. The horsepower for hoisting, however, will vary with the depth of the well and the hoisting time that the operator thinks is required for the economical operation of the rig; but the power peaks for this duty are of short duration, and it is entirely proper to rate the drawworks engine at its maximum capacity. On the other hand, the engine driving the mud pumps must operate about 80 percent of the time with a heavy load, so it should not be forced to carry continuously a load higher than its rating for continuous duty. These sturdy engines, however, may be operated at ratings exceeding the ratings given for a day or so when there are drilling operations requiring more volume or higher pressure on the pump to save time on certain jobs where such time saved more than offsets the wear on the prime mover. This type of engine is suited to withstand such punishment.

One of the chief claims made for this layout, considering the nature of the service and the general lack of trained operators, is simplicity of design and operation. This type engine has been used for many years in pumping and pipe line service and has been chosen because of its flexibility over the four-cycle engine, its having no valves and hence no actuating mechanism requiring maintenance and valve grinding.

### Advantages of Compounding

Some rigs powered with two engines are connected in such a manner as to preclude any possible chance for compounding when hoisting. This arrangement is a sacrifice of flexibility and safety. During the last year or so there have been developed very simple and practical arrangements to employ the combined power of the two engines for hoisting. This has been worked out to obtain greater hoisting speed and to safeguard the rig, making it possible to use either engine to come out of the hole or to operate the slush pump or both in case of trouble with one of the engines. A general idea of this method is shown in Fig. 8, a V-belt drive on a Cummins engine. The arrangement also makes it practical to use the same size engine for drawworks and slush pump operation so that more power will be available in case of trouble with either engine and to insure ample power for hoisting.

Ample power for the hoisting operation is without doubt the chief consideration; however, it has been the practice of many operators to use more than half as much power as is required for hoisting, so that if two engines of the same size are used the power required for the slush pump determines the minimum size engine required. The need for greater flexibility and reserve power for fast drilling has led to other methods, particularly electric-driven rigs.

While the mechanically-driven rig as yet is not so flexible as the steam or electric drive, many improvements are being made, and possibly in the next few years these rigs may be developed to the point where they will rival the steam or electric drive in

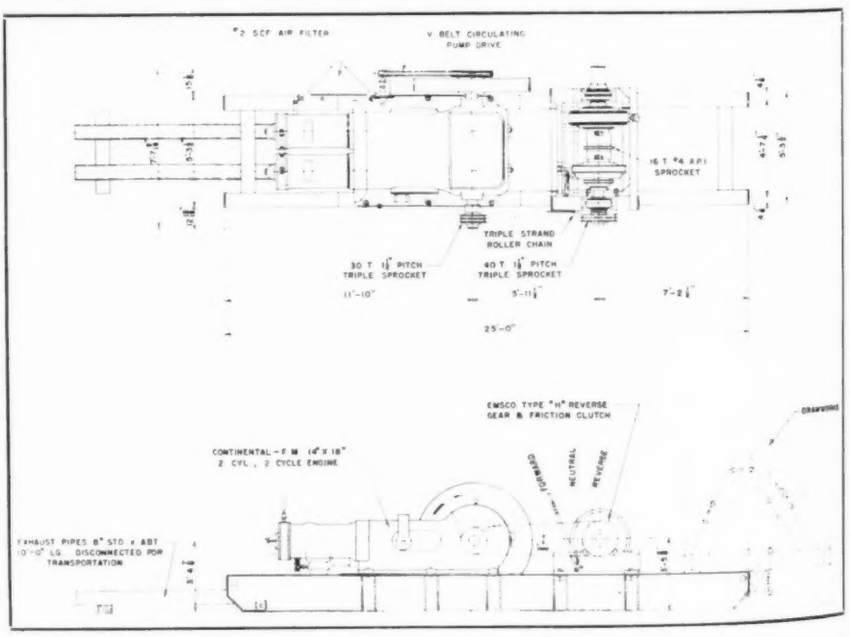

#2 SCF AIR FILTER
V BELT CIRCULATING PUMP DRIVE
16 T #4 API SPROCKET
TRIPLE STRAND ROLLER CHAIN
30 T 1½" PITCH TRIPLE SPROCKET
40 T 1½" PITCH TRIPLE SPROCKET
11'-10"
5'-11½"
7'-2½"
25'-0"
EMSCO TYPE "H" REVERSE GEAR & FRICTION CLUTCH
DRAWWORKS
CONTINENTAL - F M 14" X 18" 2 CYL., 2 CYCLE ENGINE
NEUTRAL
REVERSE
EXHAUST PIPES 8" STD. x ABT 10'-0" LG. DISCONNECTED FOR TRANSPORTATION

**Fig. 7. Slush pump drive unit**

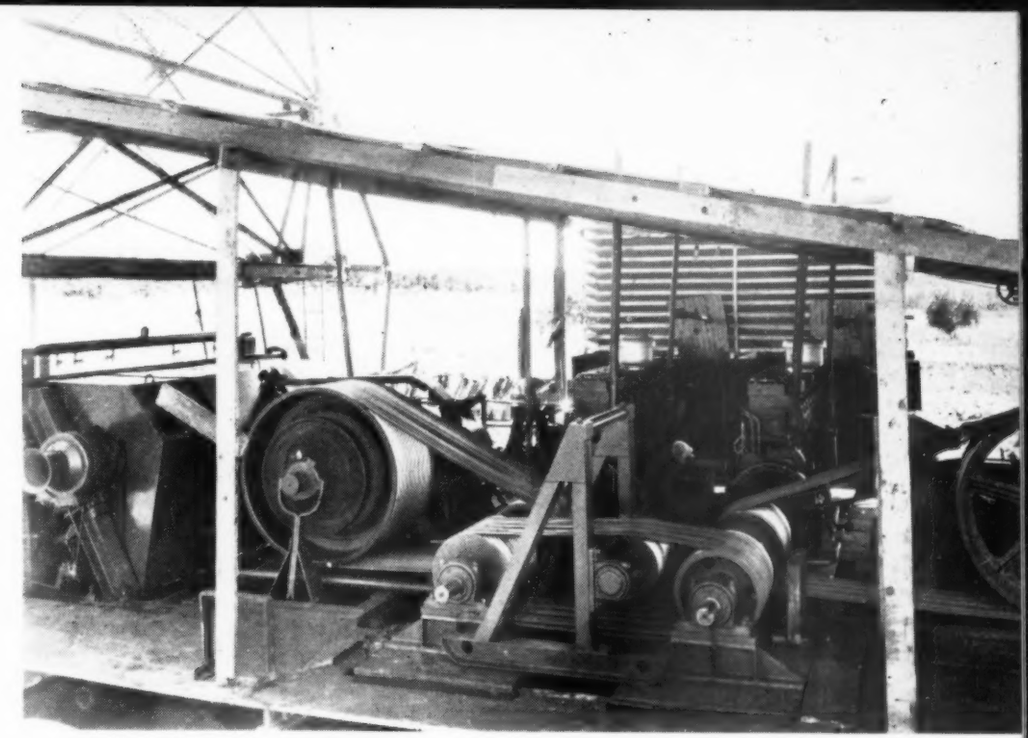


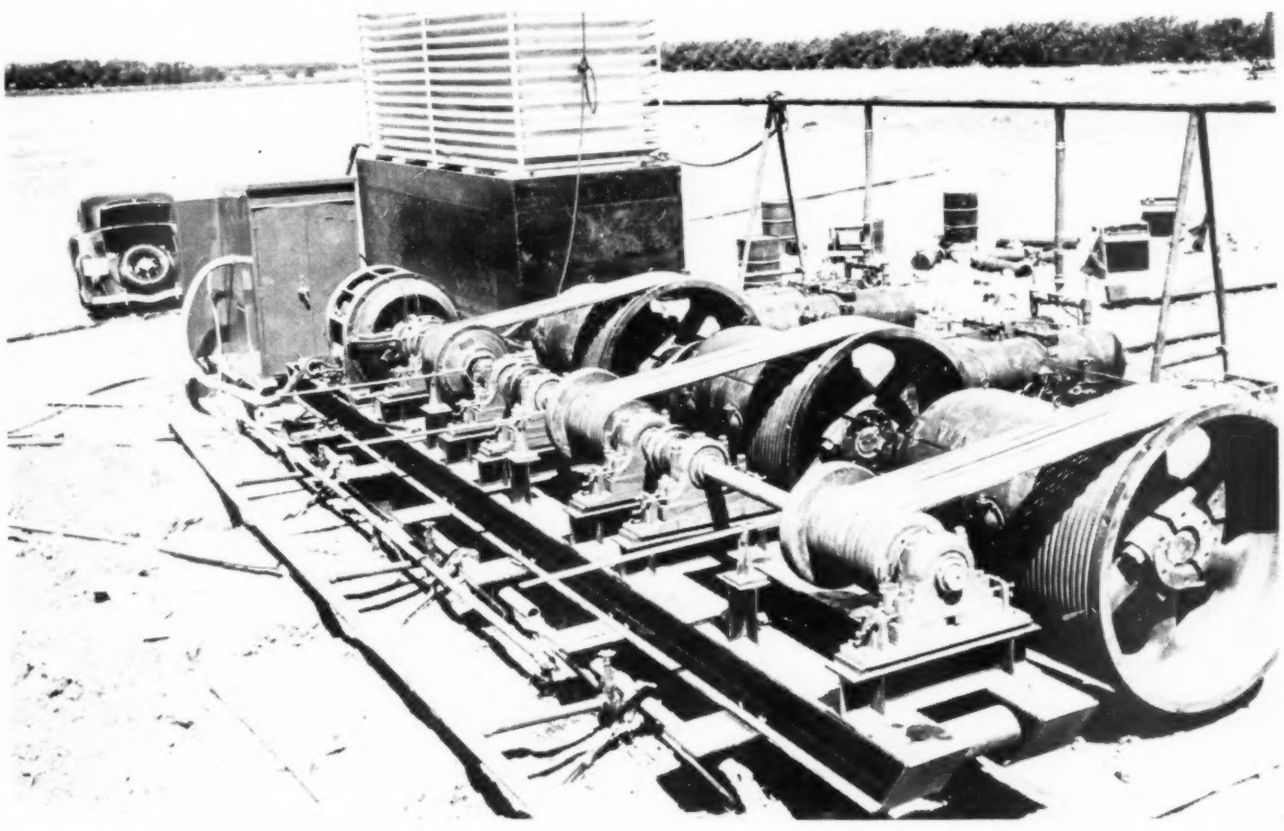
**Fig. 8. Diesel-driven rotary drilling rig. With the arrangement shown here the combined power of the two engines can be employed for hoisting**

these characteristics. A combination of three engines for electric drive to insure the utmost in power and flexibility is shown in Fig. 9. The engines, semi-Diesels, twin-cylinder, with a continuous rating of 150 hp. and a peak of 225 hp., 300 r.p.m. supply power to an induction motor-driven oil well rotary drilling rig that was in operation near Arkansas City, Kansas. The unit mounting of the combination drive, with V-belt to drive one generator, has been recognized in practice as a good solution to the problem of ample power and flexibility, though at increased cost of installation.

### Clutch and Transmission Chief Element of Mechanical Rigs

The clutch and transmission arrangement is the main factor in the success of the mechanical rig. Clutches with capacity to transmit the power of engines as large as 300 hp. maximum rating have been developed, such clutches being manually operated without difficulty. Clutches of larger size require power-operated attachment, usually compressed air. Since they are built heavy and designed to transmit the power of the engines at low speed, the clutches must be properly balanced as to centrifugal forces and friction between the working surfaces. Although at this time improvements are being made in the design and construction of heavy-duty clutches to permit the use of the largest-size Diesel engines for mechanical drive, considerable work and experience must be gained before the ultimate value of such arrangement can be determined. A practical limit to the size of the engine that can be handled with a clutch and mechanical drive has not been determined as yet; however, it is thought that for rotary service larger than 500 hp. should not be undertaken at the present time except on an experimental basis.

**Fig. 9. A combination of three engines for electric drive to insure the utmost in power and flexibility**



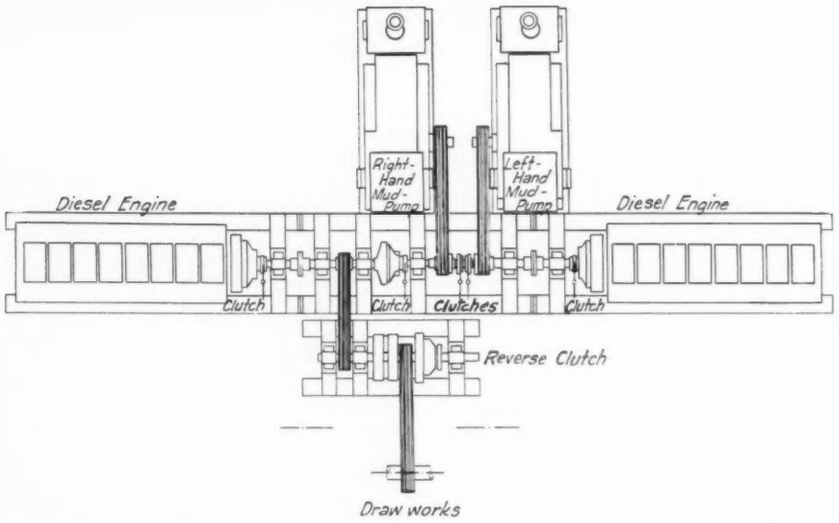



**Fig. 10. A modern Diesel-mechanical rotary drilling drive—this hook-up is compact and provides maximum flexibility**

### Diesel Electric Drive Developments

Considerable engineering work has been done in connection with the problem of proper selection of the engine, and the application of the electric transmission apparatus, with the result that electrical drives having the required operating characteristics now are available.

The electric drive as such is under development with the aim of providing units with extreme flexibility of control, maximum utilization of available power, and protection of the rotary equipment during drilling. The advantages to be expected from a highly developed Diesel electric-drive applied to rotary drilling may be summarized as follows:

1. The driving engines may not be overloaded beyond a predetermined point for any condition, thus permitting the engines to be run at a constant speed best suited for the horsepower required. This may be accomplished by the electric drive with proper control.

2. The torque that the drawworks and slush pump motors can develop may be definitely limited to values within the capacity of the rig, thereby automatically protecting the drilling rig, slush pumps, and electric equipment against damage from excessive overloading. This is a protective advantage.

3. The drive may be so designed that it combines the fineness and flexibility of control of d-c. motors with operating characteristics similar to those of a steam engine. This makes for safety in operation, low upkeep and maintenance cost, and low overall economy.

In addition to providing these essential advantages to offset the additional cost of installing Diesel prime movers, the properly developed Diesel-electric rig has certain desirable operating characteristics, among which are:

(a) A wide range of speeds for the drawworks drive.

(b) A means of positively indicating any restriction or stoppage of mud circulation, and of automatically increasing the pump pressures, thereby restoring full circulation without forcing a shutdown.

(c) Availability of the combined capacity of both engines for heavy drilling service or heavy hoisting duty when coming out of or going into the hole.

(d) Individual controls for the drawworks and mud pumps. All controls being placed at the driller's position render it possible to make instant changes and have full control over the entire operation.

(e) Arrangement for the use of either power unit for coming out of the hole or continued drilling at reduced speed in event of failure of the other unit.

Power equipment that will comprise a complete unit of this nature consists of the following:

1. Diesel engines, at least two, approximately the same size, with generators.
2. Main control unit.
3. Electrical-control apparatus composed of push-button stations, driller's control, and switching devices.
4. Drawworks motor with motor-driven blower.
5. Slush pump motors, one or two with blowers.
6. Rotary drilling reduction gear.
7. Slush pump drives, V-belt or chain.
8. Auxiliary engine-driven generating set.
9. Motor-driven wash-down pump.
10. Electric cable and apparatus.

One of the latest designs of a power unit of this type is an opposed-piston Diesel-electric rotary drilling unit that employs the Ward-Leonard system to generate d-c. current for drilling. This unit is comprised of equipment intended to afford advantages and meet the requirements just outlined. A feature of this drilling power is the construction of the generator units as

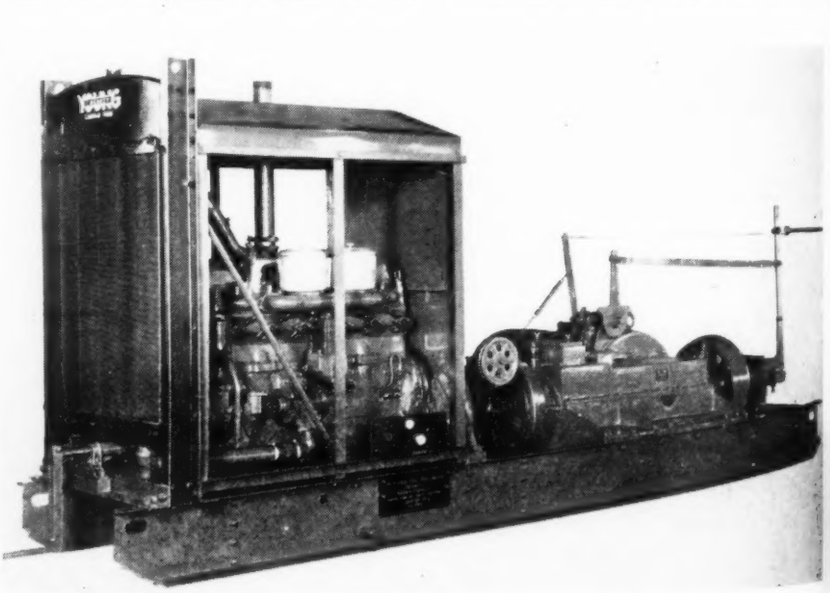


**Fig. 11. Diesel drilling outfit adapted for moderately deep drilling—cable-tool or rotary**

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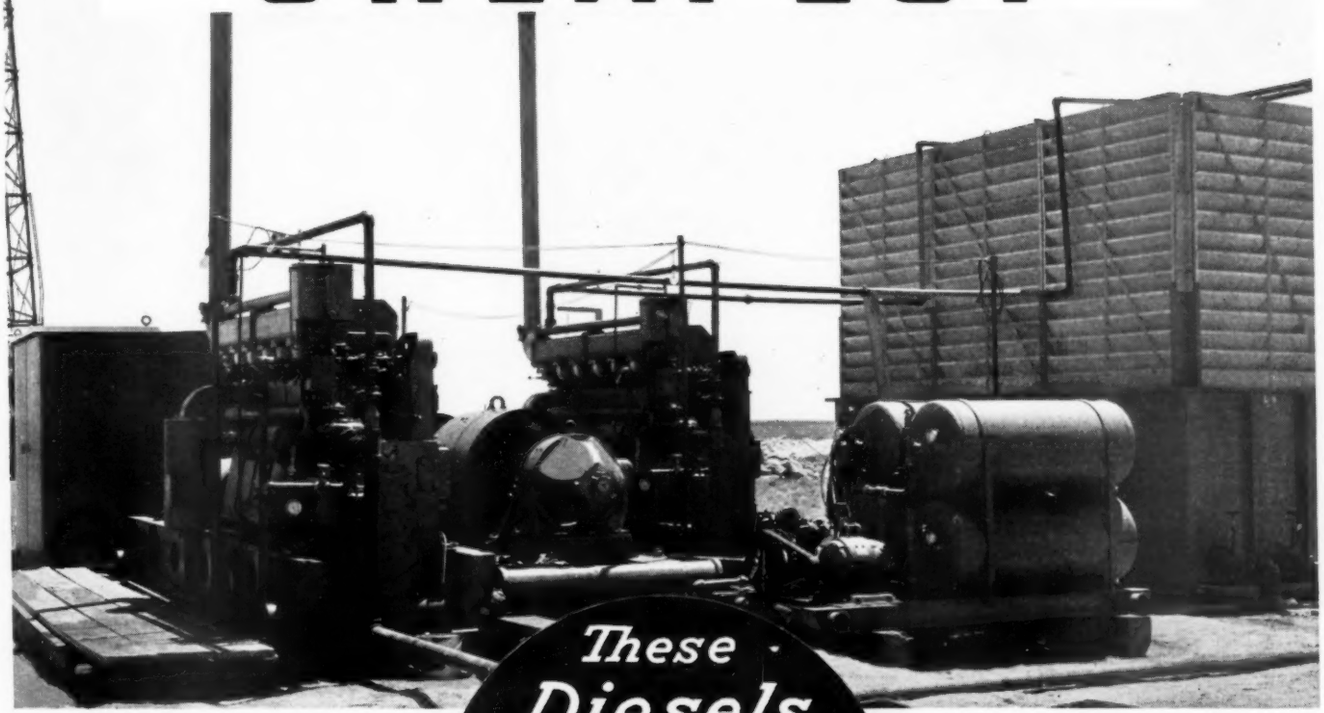
# CHEAPEST



## *These Diesels slash Rotary-Drilling Costs!*

**Two Cooper-Bessemer Type FP-6 Diesel engines rated 240 H.P. each driving 185 K. W. direct current generators through V-belts on a Diesel electric drilling job in West Texas.**

Diesel Drilling is new enough to be classed as a modern method; yet it is old enough to furnish convincing cost-records as to its downright economy over a period of years.

There are a great many rotary-drilling sites where it is decidedly uneconomical (in some cases, not feasible) to use anything but Diesel power.

Cooper-Bessemer Diesels have been in continuous rotary-drilling service for the last six years. During that time, they have paid for themselves many times over, and are still drilling wells.

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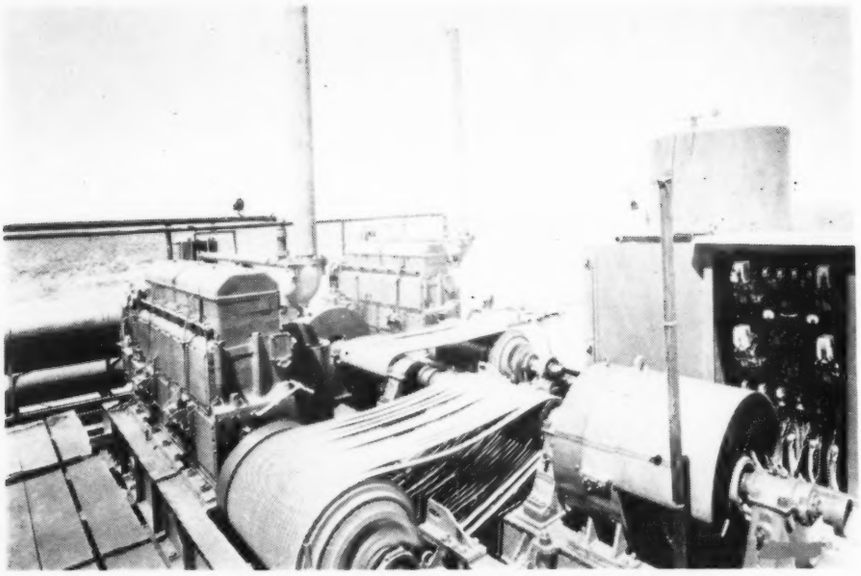


**Fig. 12. Diesel drilling power driving alternators through V-belt drive—Monument field, New Mexico**

complete power plants, mounted, housed, and entirely self-contained, with fuel oil lines leading into one end of each unit and electric power cables out of the other end. The engine is the 2-cycle, opposed-piston type, which develops maximum power within reasonable weight and space limitations, and relatively high rotative speeds with conservative piston speeds. The engine is firmly bolted to the cross-members of the base, these cross-members having machine pads upon which the engine rests to obtain rigid mounting and maintain good alignment in operation. The generators likewise are mounted on rigid cross-members with machined pads. The units are substantially housed and provided with protection against dust, damage to the electric equipment, and other accidental occurrences. There are two radiators, one cooling the lubricating oil and the other the circulating water, both being mounted on the main skid beams on the opposite end from that of the engine. The fuel injection system is of the solid injection type employing individual pumps for each cylinder, and all parts are pressure lubricated. Inclosed, separately-ventilated, d-c., rotary drilling motors drive the drawworks through a reduction gear.

Under normal drilling conditions, both units are utilized, employing the four generators and the two exciters. Two 140-kw. generators operate in parallel and pull the slush pump motor. Two 50-kw. generators operate in parallel and pull the drawworks motor for rotating. One of the exciters provides all field excitation, while the other supplies power to the blower motors, lights, and other auxiliary load. When used in shallow drilling, or during an emergency, it is possible to operate with but one generator set, this being provided for by the control. During such an operation the slush pump motor is pulled by the 140-kw. generator, and the drawworks motor by the 50-kw. generator, one exciter providing current for excitation and the auxiliary load.

The generators and control equipment are designed to operate over the 900 to 1200 r.p.m. speed range, and the engine governors control the engine at any speed within these limits. In this manner it is only necessary to operate the units at their full rated speed of 1200 r.p.m. when maximum power is needed. The units are operated only at a speed sufficient to develop the required continuous horsepower output.

The type of electrical control, generator, and motor characteristics limit the continuous load that can be imposed on the engine to the value of the continuous hp. rating of the engines at the speed at which they are running. In this manner, the engines are fully protected against any detrimental continuous overload.

During pulling operations, when peak power is desired, the control and the drawworks motor and generator characteristics permit a peak of 360 hp. per unit, or a total of 720 hp., to be imposed on the engines. This hp. is below the actual peak available in the engine and, therefore, safely protects the engines against overloading.

Another Diesel-electric power unit (see Fig. 11) for drilling has the electric generators and exciters mounted in a straight line on a common steel base. Two Diesel engines, one on each side of the generator unit, drive the generators through two V-belts or chain drives. D-c. power is generated for drilling. The hp. ratings of the engines are conservatively based on 75 lb. M.E.P., giving a large emergency overload capacity. The d-c. electric transmission makes possible close adjustment of speed and torque, from zero to full load at standstill, and from

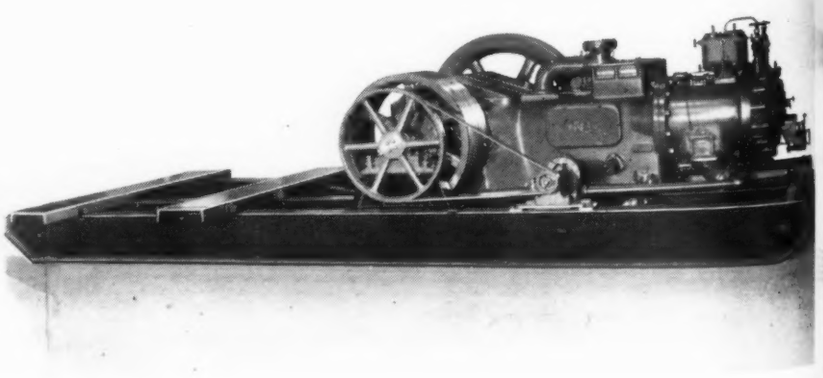
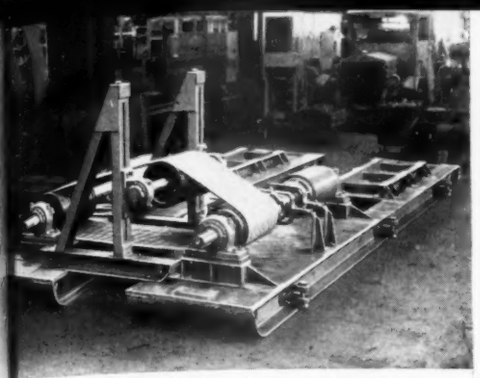


**Fig. 13. Horizontal twin-cylinder Diesel adapted for both cable-tool and rotary rigs.**



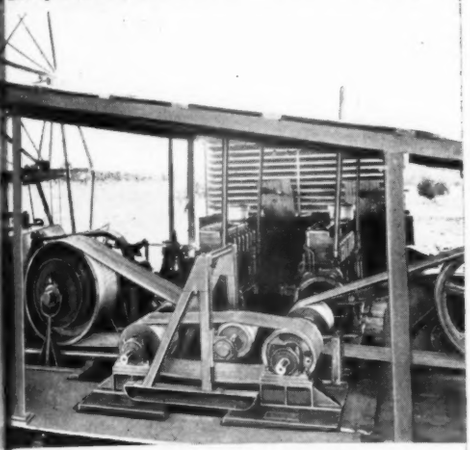
gine Bases, Texrope Drives and Tightener 240 hp engines, for Mechanical Drilling Rig.

# Drilling Rigs to Suit Varied Requirements

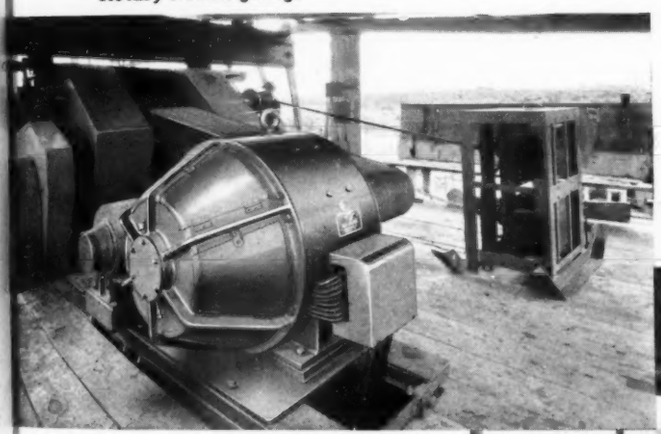
● Texrope drives have proved their dependability to transmit power economically under severe operating conditions. They have made possible new combinations of equipment for drilling and for pumping. Their flexibility and short centers have permitted close coupling of the various units, such as motor to drawworks or slush pump or motors and engines to generators. Texropes cushion the shock, will not slip and require little care.

● One of the mechanical combinations using Texrope drives is shown below. Two 200-hp engines are driving a rotary drilling rig through Texrope Drives. This conventional hook-up allows compounding of engines for hoisting, individual operation of pumps and table, or operation of both pump and table by either engine.

● Allis-Chalmers pioneered in the development of heavy duty d-c rotary drilling equipment, building engine driven units either direct connected or belted to the generator. General advantages are: Flexibility of control, non-stalling of engines, ease of rigging-up; reliability; protection against excessive shock; economy in fuel and water. Exclusive features of Allis-Chalmers d-c rigs are: Single engine operations; self-contained blowers; separately driven exciters; and electric starting for engines where desired. By substituting an induction motor for the engine, this rig may be used for operation from a-c power lines.

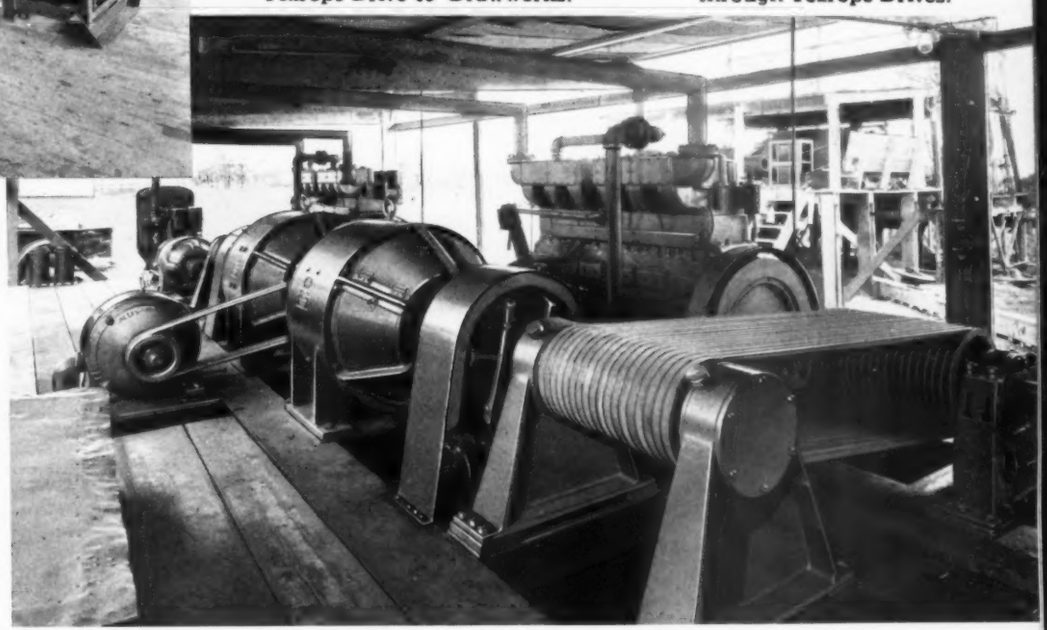


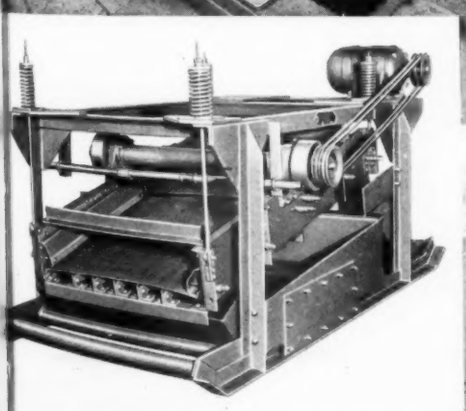
Allis-Chalmers Texrope Driven Mechanical Rotary Drilling Rig.



Left: Hoist and Drill Motor with Texrope Drive to Drawworks.

Below: Generator Driven by Engine through Texrope Drives.





Allis-Chalmers "Shale Shaker" Mud Screen.

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MILWAUKEE WISCONSIN

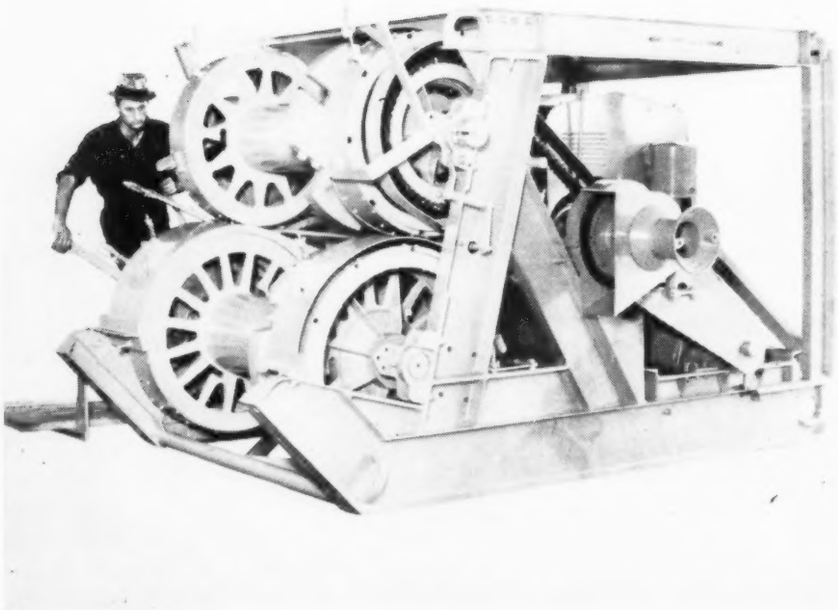


**Fig. 14. Four-cylinder Diesel engine direct-connected to double-drum hoist with rotary drive**

zero to full speed at full-load torque. Due to the inherent characteristics of the variable-voltage system, the motor torque will not increase suddenly to impose shock loads on the chains, belts, drill pipe, or other transmission equipment, nor can the motor speed increase suddenly. The engine cannot be overloaded to the stalling point, although 200 percent full-load engine torque, or 125 percent of full-load engine speed, can be transmitted to the driven member of the rig by the electric motor. The operation is as follows: For normal drilling, the drilling motor is fed by generator No. 1. Pump motor No. 1 or No. 2 is fed by generator No. 2. While drilling and mixing mud the drilling motor is fed by generator No. 1, pump motor No. 1 by generator No. 2; pump motor No. 2 mixing mud is fed by generator No. 1, or pump motor No. 2 pumping, fed by generator No. 2, and pump motor No. 1 mixing mud is fed by generator No. 1. For normal hoisting the drilling motor is fed by generators No. 1 and No. 2 in series. In emergency hoisting, the drilling motor is fed by generator No. 1 or generator No. 2. It thus can be seen that the system is entirely flexible and meets the demands for flexibility and control for wells of 5600 to 7000 ft. in depth. The fuel pumps and spray valves and governing system are designed to insure equal distribution of the load to all cylinders. Double fuel pumps with lapped plungers, and spray valves with lapped needles, eliminate troubles common to engines that use packing in these parts. The lubricating system is of the forced-feed, dry-sump type, and the fuel oil and lubricating oil are filtered.

All auxiliaries are built in and the engine is practically self-contained. The units can be assembled and set up in a minimum amount of time and so reduce rigging-up expense. Much of the demand on such drilling rigs is rush demand for time and capacity; a unit to meet this condition must have nothing missing if results are to be satisfactory.

The production and use of the Diesel-driven, d-c., variable-voltage drilling rig has gone rapidly forward in the last year or two. Extensive application of this type of rig may be expected following the development now going on.

Several applications of other types of rigs, and their various arrangements are shown in accompanying illustrations.

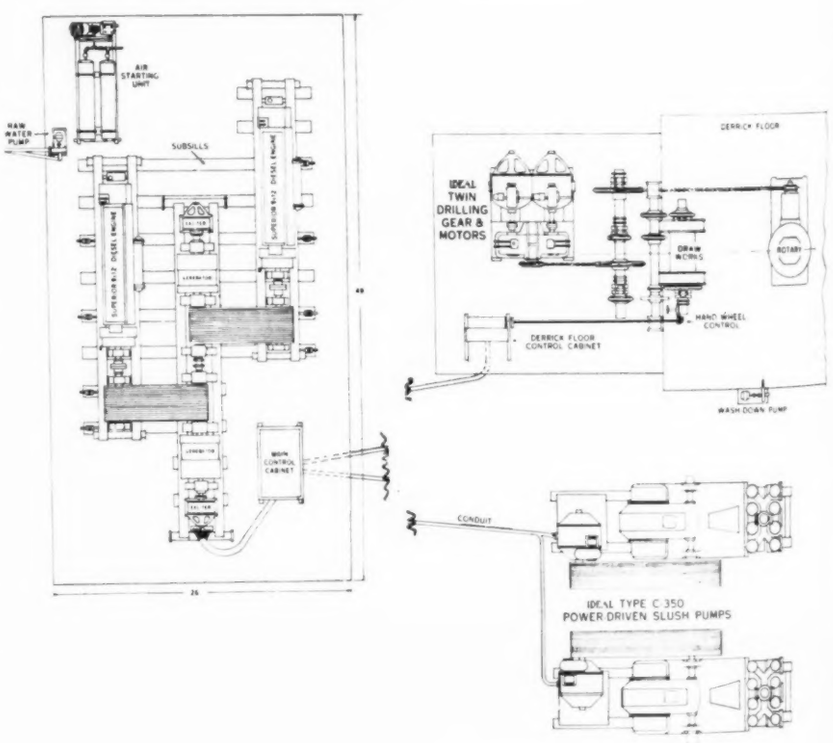
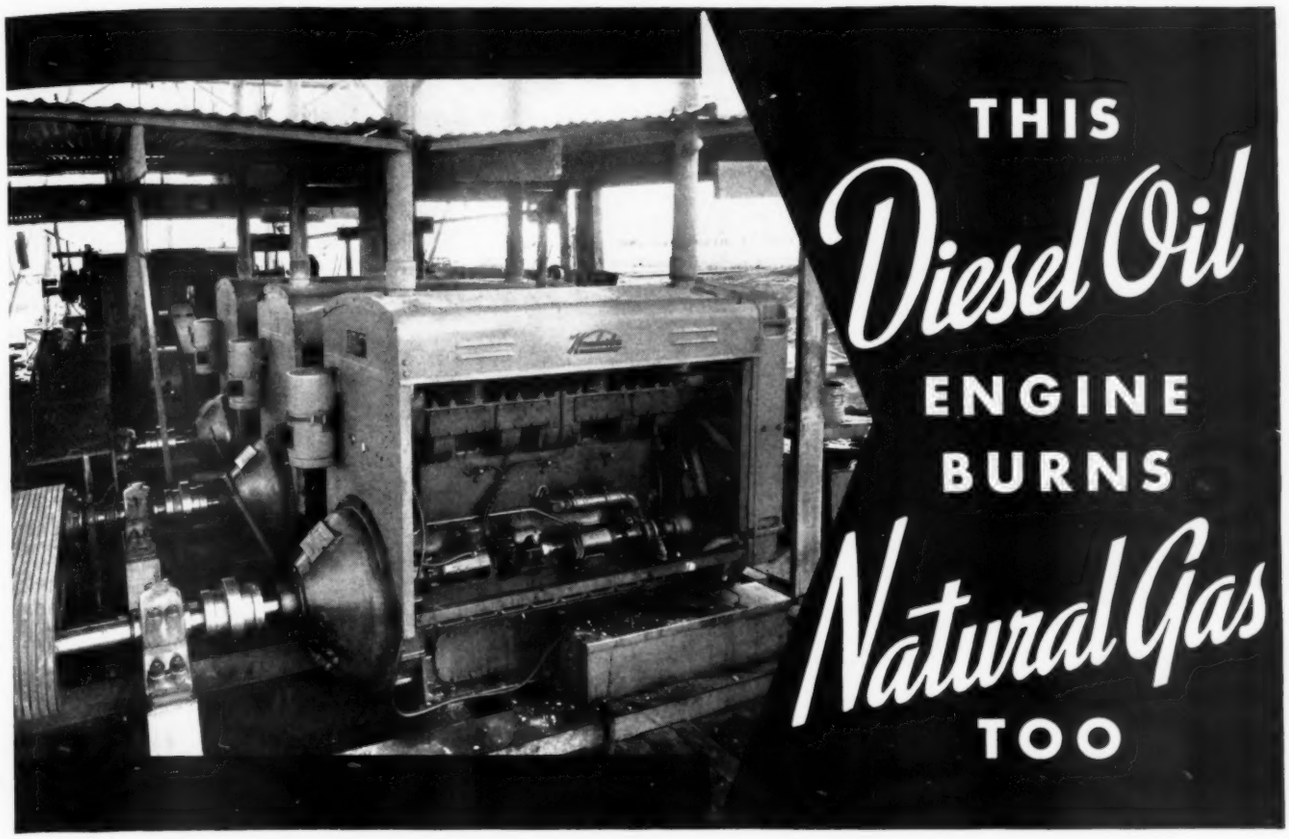



**Fig. 15. Layout of a modern heavy drilling rig powered with two large Diesel engines connected by V-belt drive to generators developing d-c. power by Ward-Leonard system for rotary drilling**



# THIS *Diesel Oil* ENGINE BURNS *Natural Gas* TOO

This triple engine hook-up rig is one of four rigs which Mr. H. L. Blackstock of the Blackstock Oil & Gas Co., Oklahoma City, has equipped with ten Model ELH 190-195 hp. Waukesha-Hesselman Oil Engines to replace steam.

The Hesselman is an engine that burns diesel fuels but Mr. Blackstock is operating with gas because the low compression of the Hesselman engine makes it suitable for either fuel—an advantage not found in high compression Diesel engines.

Mr. Blackstock has drilled wells up to 7000 ft. The three Hesselman engines use about 75000 cu. ft. of gas daily. Gas has proved equally satisfactory as to economy and performance...and as good or better time has been made than with steam rigs.

To convert this Waukesha-Hesselman from an engine burning diesel fuel to a gas engine, it is only necessary to install gas burning accessories in place of the fuel oil equipment—pistons, valves, cylinder heads, connecting rods, crankshaft, and bearings remain exactly the same.

Here's the reason—the Hesselman is the only solid injection oil engine with electric spark ignition which permits compression ratios low enough and exactly suited to natural gas. For wildcatting or in proven fields, this Hesselman is the ideal rig.

You'll want the details . . . write today for Bulletin 1045. *Waukesha Motor Company, Waukesha, Wisconsin.*

**WAUKESHA ENGINES**

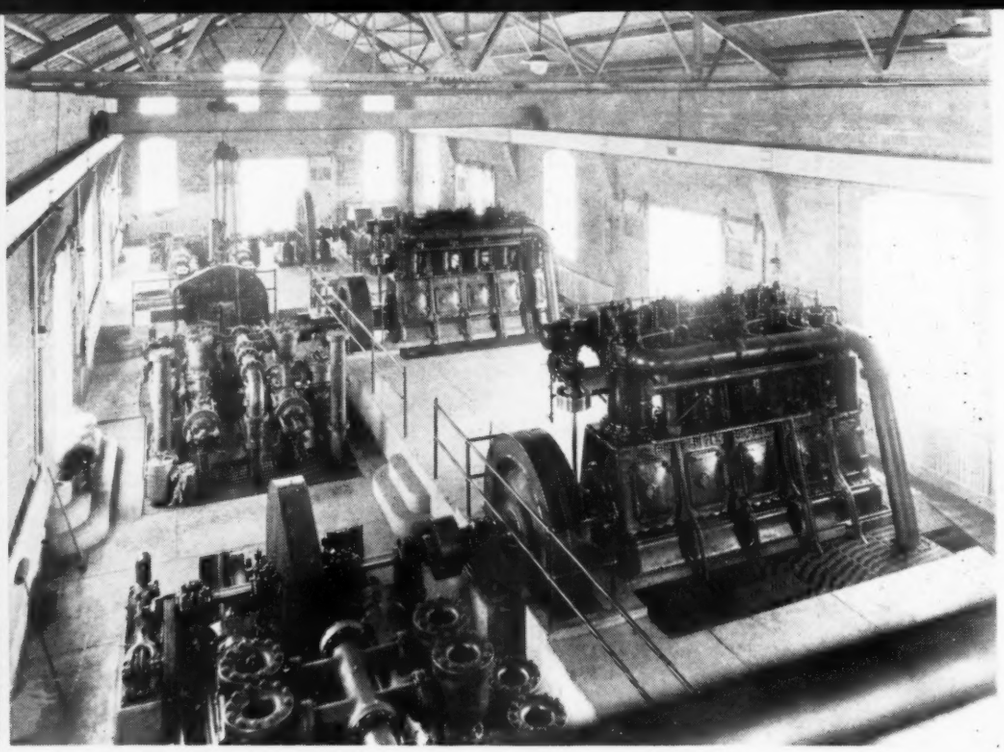


Fig. 2. An early installation of a 250-hp. Diesel engine at Hominy, Oklahoma, in station of Stanolind Pipe Line Co.

**First extensive use of Diesels in the petroleum industry was for transportation of crude oil through pipe line systems**

# Oil Pipe Line Pumping with Diesel Power

FOR a number of years oil pipe line companies were among the leading users of Diesel engines. It was from this industry that the builders of the early engines received great encouragement and assistance, and even before the Diesel engine became important as a prime mover it had established itself in the field of oil pipe line transportation. Due to the severe operating requirements and the need for continuity of service and reliability in this field, the Diesel engine was given ample opportunity to test its inherent ability to stand up under prolonged non-stop runs, and operate economically.

A variety of applications for oil pumping and transportation is to be found, varying from small pumping engines to large Diesel-powered tankers and sea-going craft for the transportation of refined and crude oil. Perhaps the most important use is in oil pipe line pumping service, a nation-wide common carrier industry within itself. Diesel engines are employed in pipe line stations for transporting crude oil from the oil fields to distant refineries or to ports for shipment coastwise or overseas.

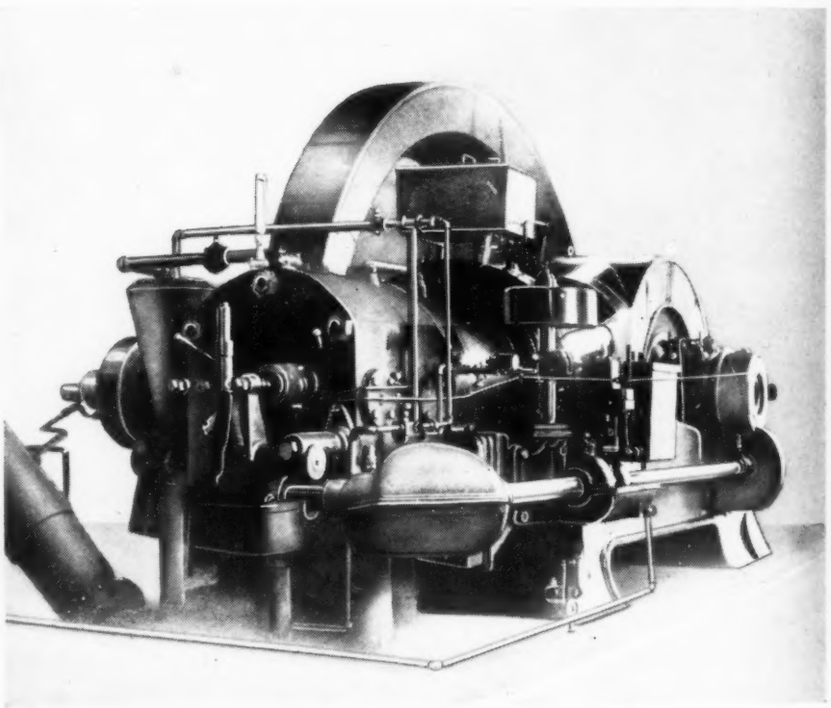
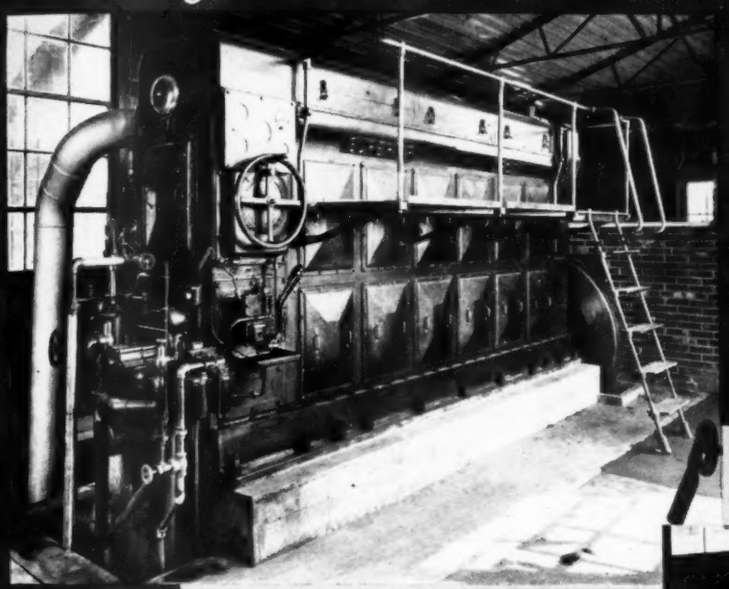


Fig. 1. One of the first oil engines used in pipe line service, installed in 1907 on system of Gulf Pipe Line Co.

### First Pipe Lines

The first known pipe line was a 2-in. line five miles long that was laid at Oil City, Pennsylvania, in 1865; a 4-in. line 60 miles long from the same fields to Pittsburgh was completed in 1875. This had been extended to a length of 3000 miles by 1896. At the present time a large volume of Mid-Continent oil is transported by pipe line to refineries and to seaports in the Gulf Coast area, to Houston, Galveston, New Orleans, Beaumont, Port Arthur, and Baton Rouge, from where it is shipped in tankers to the Atlantic seaboard market and abroad. A large volume also is pumped directly from the fields to refineries north and east, and to local refineries that are many in number and well distributed over the Southwest. With the opening of the East Texas field, greater pipe line facilities than ever before were developed and the capacities of older lines increased. This resulted in many

# Superior DIESELS for PIPE LINE SERVICE



Six-cylinder, 12½" x 15", 400 H. P. Superior Diesel driving 3450 R. P. M. main line booster pump through speed increaser.

These views are typical of many Superior Diesels in pipe line stations with a splendid record of continuous dependable service.

Specially adapted by their variable speed and wide range for either direct drive or through gears.

Convertible to gas.

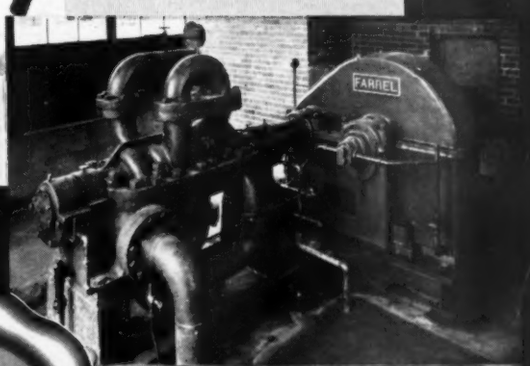
Slow, medium or high speed with ratings from 25 to 800 H. P. to meet all conditions.

* * *

Portable Diesel pumping units for gathering lines, etc.

* * *

Diesel Generator Sets 10 K. W. and up.

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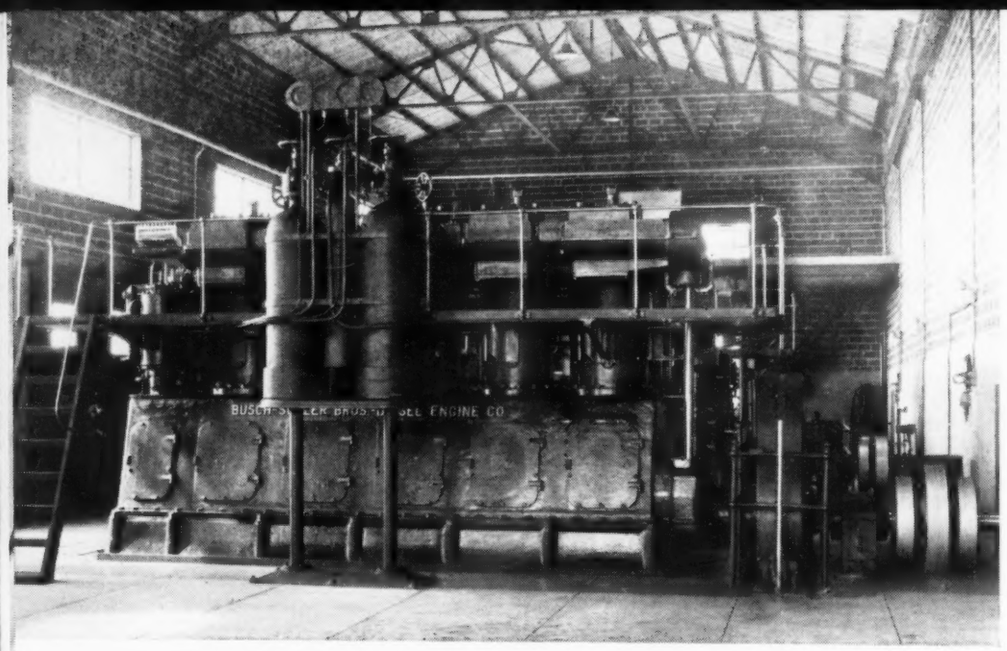
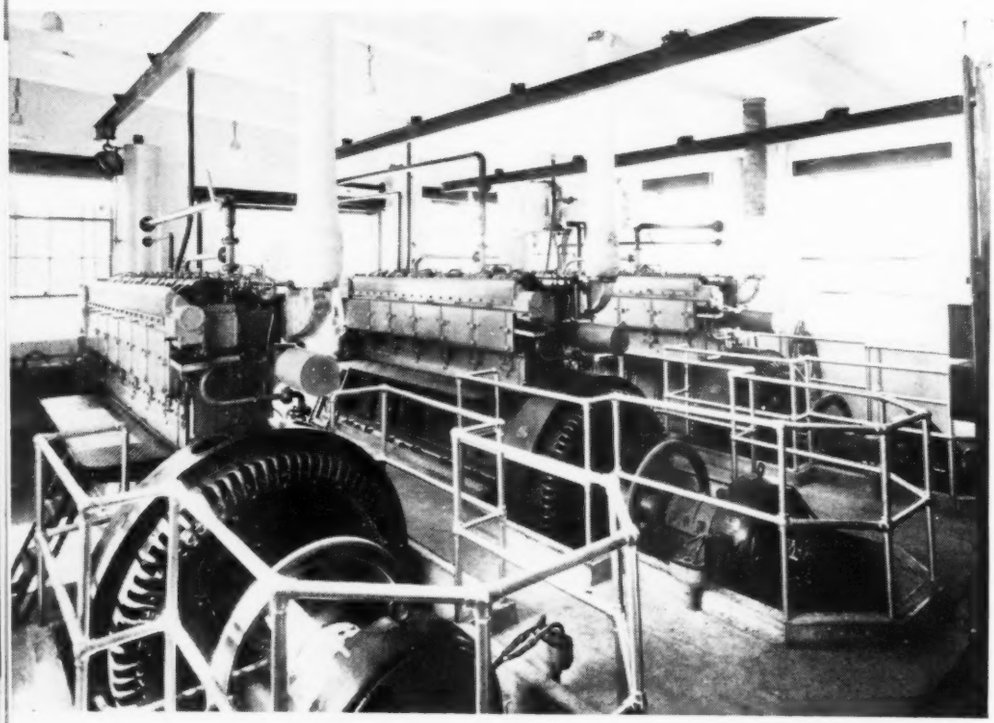
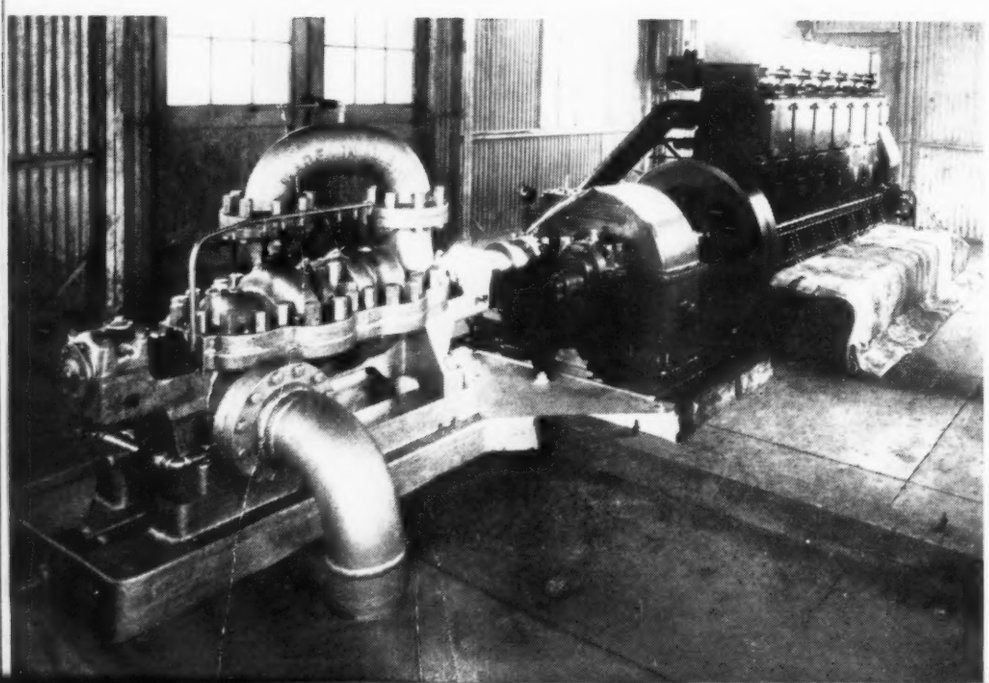






new Diesel engines being put into pipe line service.

The trunk pipe line operates 24 hours a day, so that the construction and materials are the very best. The cost per mile of laying an 8-in. line is from $15,000 to $20,000. There may be one or several lines ranging in size from 8-in. to 20-in. in diameter. Pumping stations are placed along the line at 40- and 50-mile intervals. Lines run in the most direct route possible, taking full advantage of elevation, gravity, etc. The stations are connected by telegraph and telephone lines to keep them in constant communication with the dispatcher at headquarters.

Many of the stations are provided with modern housing facilities for the operating crew. Each main line station receives the oil in working tanks from which the pumps pick it up and return it to the line for delivery to the next station where the cycle of recovery and dispatching is repeated. The pumps work against a pressure of about 700 lb. per sq. in. and deliver, when operating at capacity, approximately 20,000 bbl. per day through an 8-in. line. This will indicate the volume of oil handled when it is considered that there may be several parallel lines in one trunk system.

The introduction of the oil engine almost 30 years ago attracted but little attention at the time, although by 1907 a line from Oklahoma was installed by the Gulf Pipe Line Company using about 100 oil engines rated at 85 hp. each. Fig. 1 shows one of these engines. This engine was known as the De La Vergne type HA. It was modified from its original HA type to the modern injection type some 15 years ago. The engine, however, fundamentally is the original engine installed 29 years ago. It develops 85 hp. at a normal operating speed of 180 r.p.m. and is direct-connected to a vertical triplex, single-acting, plunger type pump with built-in speed-reducing

Fig. 3 (top)—A 500-hp. Diesel engine in pipe line service

Fig. 4 (center)—Three Diesel engines connected to altenators in Diesel-electric station of Atlantic Pipe Line Company at Mt. Enterprise, Texas

Fig. 5 (bottom)—A modern installation of a light-weight high-speed Diesel driving a centrifugal type pipe line pump

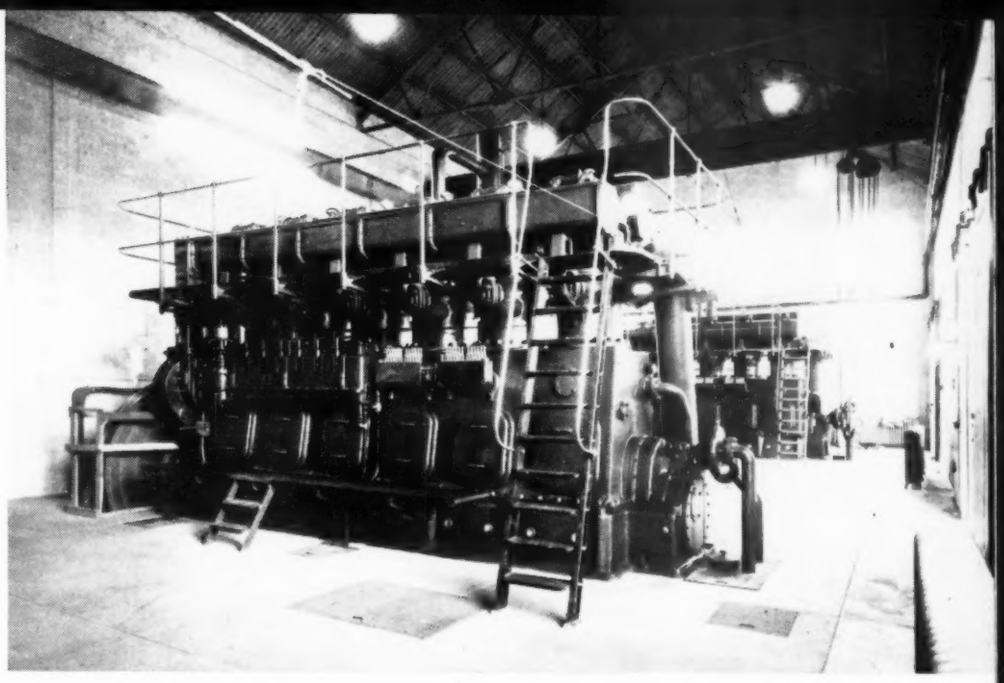
gear, the pump having a speed of about 42 strokes per minute and a capacity of approximately 5000 bbl., per day at 800 lb. delivery pressure. These heavy, slow-speed, single-acting, single-cylinder units of the earlier days of Diesel application to pipe line service were followed by installations of larger capacity in the multicylinder vertical type Diesel, some individual units as large as 1600 hp. being installed in recent years. Some of these larger units drive centrifugal pumps, and in these instances a gear speed increaser is interposed between the engine and the pump.

Those earlier engines were of the 4-cylinder, surface-ignition type, a forerunner of the 4-cycle cold-starting solid-injection engines of the present day. Shortly after the Gulf line was equipped with Diesels, the Standard Oil Company of Louisiana constructed a line from the Arkansas field to Baton Rouge, 100-hp. engines being employed. Following this, such companies as the Magnolia Petroleum Company and the Prairie Pipe Line Company installed larger units, oil engines being used extensively in these developments.

According to pipe line superintendents with whom this subject was discussed by the writer, much effort was needed in the early days to prevent engine difficulties. Until a great deal was learned by experience engines gave considerable trouble. Pipe line superintendents made much progress in their effort to improve operation and many of the modern refinements in present-day engines were suggested by them. Aided by such valuable coöperation from pipe line operating officials, the Diesel industry and the Diesel engine developed rapidly.

A large early installation is shown in Fig. 2, two 250-hp. Busch-Sulzer engines at the Hominy, Oklahoma, station of the Stanolind Pipe Line Company. These engines have been in service almost 20 years. In Fig. 3 is shown two 500-hp. engines in another Stanolind pipe line station.

Some stations may have as many as



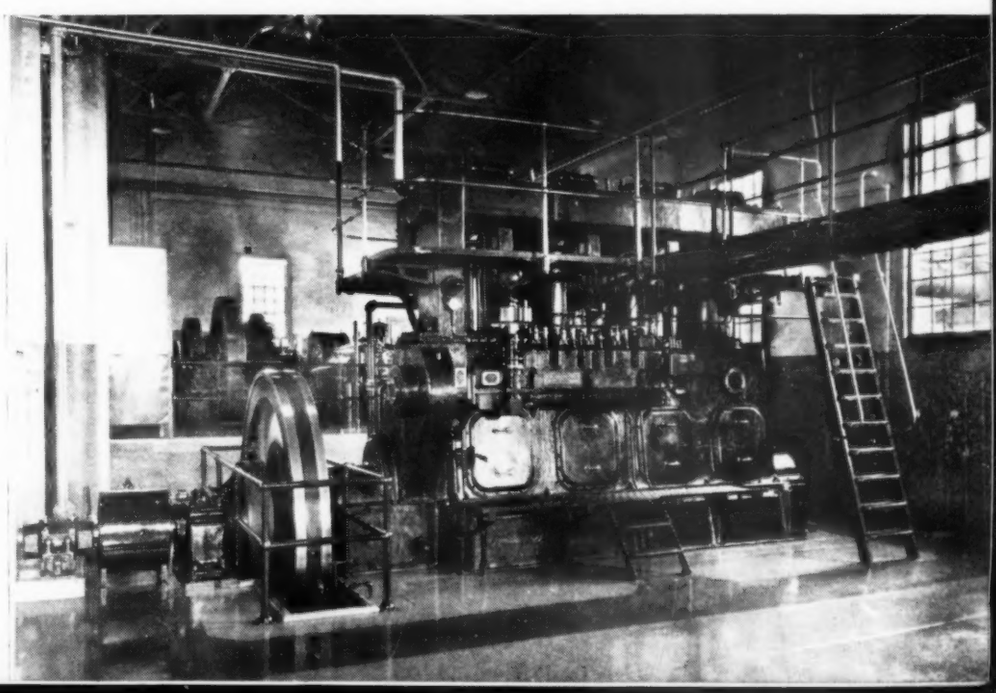


Fig. 6 (top)—Six-cylinder Diesel engines driving chain-driven pumps

Fig. 7 (center)—Showing an arrangement of pumps connected to engines through a firewall

Fig. 8 (bottom)—Four-cylinder Diesel engine direct-connected through a flexible coupling to a plunger type pipe line pump

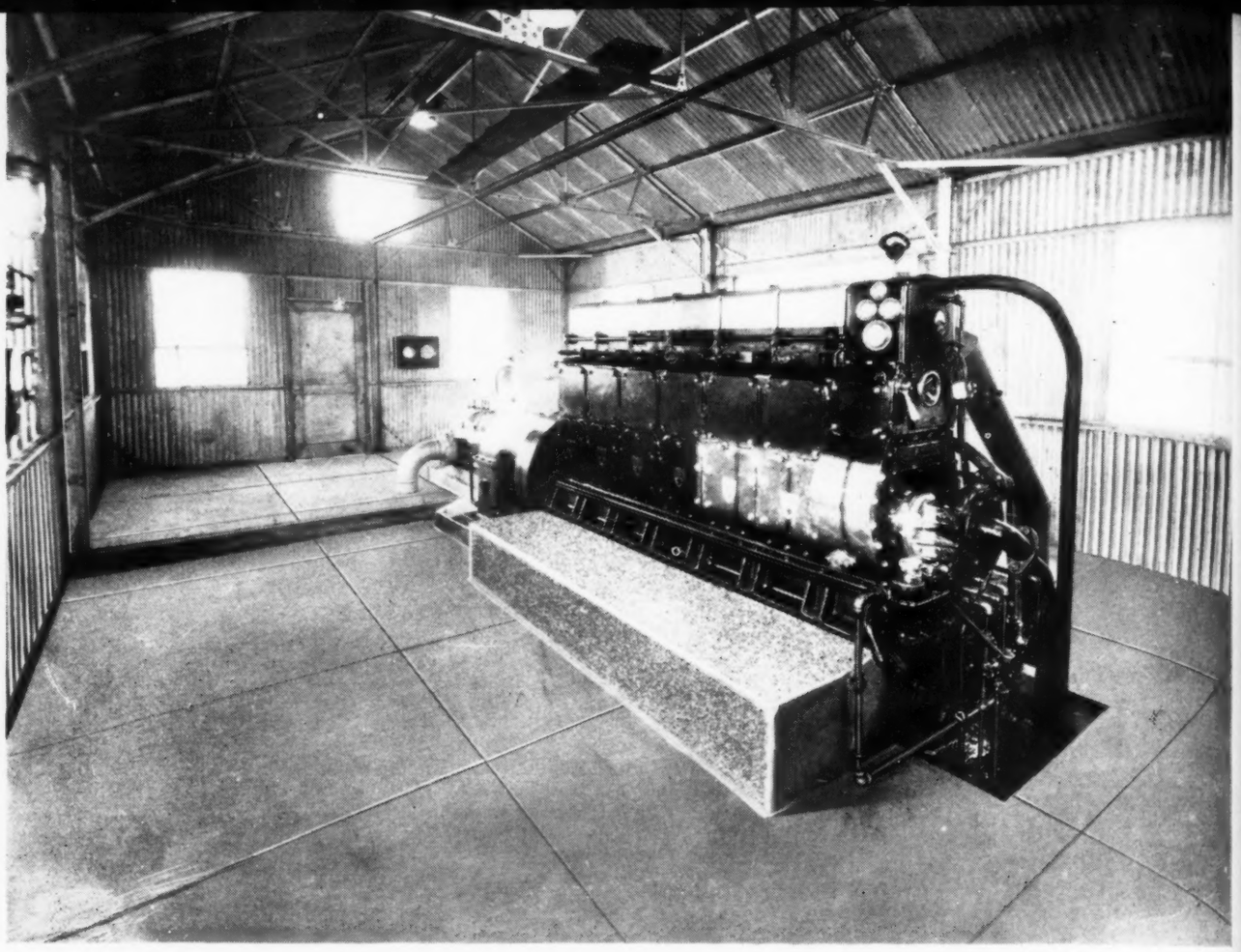


**Fig. 9. Another example of the use of the higher-speed Diesel engine. Here is shown a six-cylinder engine connected to a high-pressure centrifugal pump through a gear increaser**

ten engines of various makes or of equal size connected to generators, the pumps being electrically-driven. Diesel-electric stations employ the best in design, equipment, and installation. In Fig. 4 are shown three engines connected to 250-kva. 400 r.p.m. alternators used in the Atlantic Pipe Line Company's station at Mt. Enterprise, Texas. Many stations have been erected of which this is typical. In Fig. 5 is shown a modern installation of a light-weight high-speed Diesel driving a typical centrifugal type pipe line pump, the connection being through a gear-type speed increaser stepping the engine speed up to 3600 r.p.m required for the pump. In this unit the engine develops 300 hp., at 750 r.p.m., the gear speed increaser stepping up the speed of the pump. Installations of this character involving engines of comparatively light weight and high speed are becoming more popular for use in pumping plants of somewhat temporary character, it being the experience of the pipe line industry that the use of the heavy slow-speed Diesel, with its consequent high cost of installation, is not justified in the case of these temporary pumping plants.

Pipe line pumping stations today almost invariably utilize a firewall between the engine and the pump. The oil is pumped at a pressure of 700 lb. per sq. in. or even higher and it can be appreciated that in the event of leaks developing in the pumping system due to gasket or other failures would cause oil to be diffused into the pump room in a highly vaporized form. Should this vaporized crude oil come in contact with the hot surfaces of the engine, such as the exhaust lines, fire very likely would ensue.

In Fig 6 are shown two 6-cylinder Diesel engines driving chain-driven Goulds pumps. This installation is in the Drumright station of the Stanolind Pipe Line Company, and has a firewall between the engine and the pumps. Such an arrangement of pumps with firewall next to the engine side is shown in Fig. 7, being an installation of a similar type plant of the Phillips Petroleum Company at Oklahoma City, Oklahoma. In Fig. 5, the picture was made before installation of the firewall, the base plate of which may be plainly seen spanning the engine room between the centrifugal pump and the gear speed increaser. Fig. 8 shows a four-cylinder Diesel engine direct-connected through flexible coupling to a plunger type pipe line pump beyond the firewall. The installation is in the Sour Lake station of the Gulf Pipe Line Company. Another example of the use of the higher-speed Diesel engine is shown in Fig. 9. This is a 6-cylinder Diesel engine direct-connected through a Falk Bibble flexible coupling to a Farrell-Birmingham increaser gear, which in turn is connected through a Fast flexible coupling to a Goulds high-pressure pipe line type centrifugal pump. This installation at the Stanolind Pipe Line Company's Mexia, Texas, station, and has every feature learned by experience and engineering to make the modern application of the Diesel engine in pipe line pumping economical and successful.

### Diesel-Electric Stations

Excellent examples of Diesel engine economy in the pipe line field have been observed, employing large stations with generating equipment. A Diesel-electric station in Luling, Texas, operated by the Magnolia Petroleum Company, comprised 4200 hp., there being seven units of 600 hp. each connected to generators. According to reports available to the writer, on a long test run these engines averaged some years

# Sturdy Strength

FIG. 1741
GASO Duplex Piston Pump, Diesel Engine Drive, 54-502 Bbls. per hour.

Rugged simplicity of design—few, large parts, and extra strength where needed—have been the basic principles of GASO construction from the start.

That is why the first GASO Pumps made 20 years ago are still in service, and why these sturdy oil industry pumps have earned the friendship of oil men throughout the world. New catalog on request. GASO PUMP & BURNER MFG. CO., Tulsa, Okla. Export Office: 149 Broadway, New York.

# GASO PUMPS
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back 11.47 kw. per gal. of fuel oil. During a six-month's test run having a total of 27,953.5 engine hours with 397.5 hours off for repairs and pipe line damage, 9,030,100 kw-hr. were generated at the switch board, in addition to the power required for lights, water circulation, and fuel oil heaters. The total fuel consumed for this work, according to the Worthington Pump and Machinery Corporation, was as follows: Fuel oil, Luling Grade 28 deg. A.P.I., 786,937 gal. or 11.47 kw. per gallon. This compares favorably with numerous records reported from various fields for similar service and establishes a reliable figure for the cost of operation.

Diesel engines in pipe line service include almost every kind of engine and type of installation over a period of approximately 30 years. Capacity for continuous service at low cost has been definitely established in this field. Proper operation, of course, is essential and the operating crews found in charge of such stations usually are as efficient as those found in any service, and better trained as a rule.

### Trends in Pipe Line Pumping Practice

The centrifugal pump has been increasing in use in recent years, and there has been a trend toward employing the electric motor drive and purchased power, Diesel electric generating stations, and direct Diesel drives.

Oil pumping stations of the Texas Pipe Line Company, at Rodoflo, Luther, and Starr, on the trunk line system out of the East Texas field, are powered each by a 750-hp. McIntosh & Seymour engine; excellent results were reported immediately after installation. The operation of some of the new oil-pumping equipment in the stations of the Texas Pipe Line Company have been watched with interest. Instead of conforming to the usual practice of stepping down the engine speed of about 200 r.p.m. to between 40 and 50 r.p.m. to drive reciprocating pumps, an engine speed of 360 r.p.m. is employed and is stepped up through gears to two shafts running at 1800 r.p.m. and driving two multistage centrifugal pumps connected in series and operating at pressures as high as 750 pounds. Instead of the usual method of delivering into and out of working tanks, the crude oil merely goes through the pumping unit and on its way. As much as 34,000 bbl. a day have passed through one station into an 8-in. line. In the place of an elaborate cooling system with cooling tower and spray pond, a closed cooling system containing only 25 bbl. of water serves for cooling the engine cylinders. In this system, originated by The Texas Company's engineers, the heated jacket water passes into a 13-in. by 16-in. vertical cylindrical tank, is pumped through a tube nest heat interchanger in the crude oil suction line, through the lubricating oil cooler, thence through the engine cylinder jackets and back to the supply tank. The circulating pump is driven from an extension on one of the main pump shafts. A small generator belted from the other main shaft to supply lighting current completes the equipment.

The simplicity, compactness, and convenience of the small engine, small pumps and all accessories permit of a very small station that can be erected and running within 30 days, and be decidedly economical in both initial and operating cost.

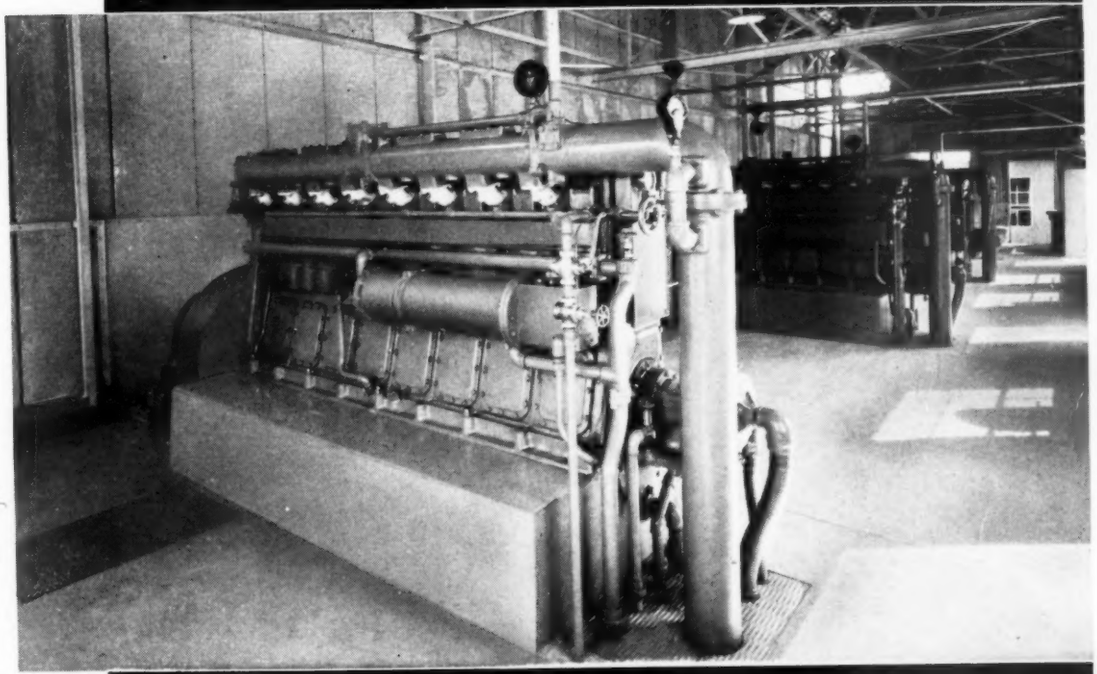
In Fig. 10 are shown the elements of a Diesel pumping unit, comprising a compact high-speed unit, a standard-type step-up gear, and a pump of the multi-stage type employed in oil pipe line pumping. This unit is typical of the new Diesel equipment that is being successfully employed in this field.

Fig. 10. Elements of a Diesel pumping unit; typical of the new Diesel equipment now being used in pipe line service

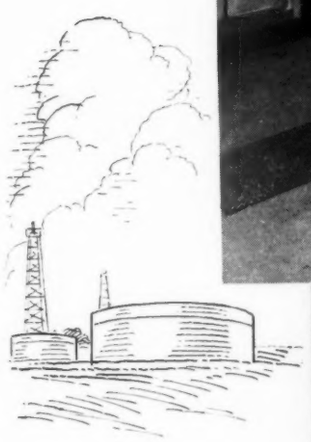
FIELD STATION DIESEL PUMPING UNIT
De La Vergne Engine
150 H.P. 900 R.P.M.
WEIGHT 6000 LBS.
Farrel-Birmingham Gear
RATIO 3.912 TO 1
TOTAL WEIGHT OF GEAR, PUMP AND BASE PLATE 5100 LBS
Goulds Centrifugal Pump
72550

# Power for Pumps Must be

# RELIABLE



Three 180 H. P. Cooper-Bessemer Engines direct-driving centrifugal oil line pumps in the Oklahoma territory.



## These Diesels are Built for 24-hour Service!

Don't let the "economy appeal" of the Diesel engine make you lose sight of the first requisite in every pumping station — RELIABILITY!

In building reliable Diesel engines for oil-line pumping, nothing can take the place of experience. Cooper-Bessemer is one of the oldest engine manufacturers in this country. The records of Cooper-Bessemer Diesels in industries where continuous operation is of first importance is the best guarantee of dependability.

Cooper-Bessemer Diesels will quickly pay for themselves in YOUR pumping stations. They cost very little to run, and require fewer hours for adjustment and overhaul.

Look into the specifications of Cooper-Bessemer Diesels. You'll find careful design, painstaking workmanship, and the best of materials — all combined to give you the greatest convenience, economy, and reliability!

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# Miscellaneous Applications of Diesels in the Oil Industry

**Wide Application of Diesels to Oilfield Service Has Resulted from Their Economy, Flexibility and Reliability**

THERE are many miscellaneous applications of the Diesel engine in the oil fields that by the very nature of things demand economy, reliability, and flexibility. Its operations are characterized by feverish activity and by the ability of men and machines to meet emergencies and find solutions to a great variety of problems as they arise. Quick action is the order of the day in many fields where delay may mean serious losses or disaster.

It has been said that no industry has presented greater problems to machinery and equipment builders than that of petroleum. It is certain that no industry depends more or makes as great demands upon machines, men, time, and money. Obtaining oil from great depths, whether in a desert location or on a steep mountain side, and the transportation of field equipment great distances, have been made possible only by the aid of the machine. Among the most important items of equipment employed in miscellaneous service in this gigantic industry are trucks, tractors, and winches.

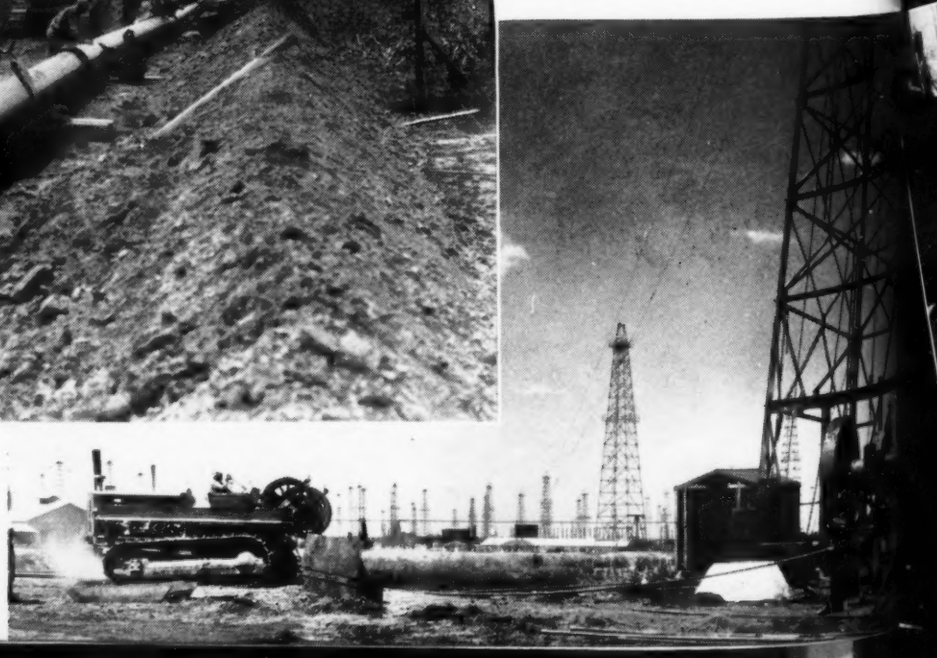
The oil industry requires more from these machines than the average power user. Operating economy and long life alone are not sufficient for the oil producer. Fuel economy, mobility, peak power for emergencies, flexibility, versatility, are the qualities demanded of the engines employed in the oil field.

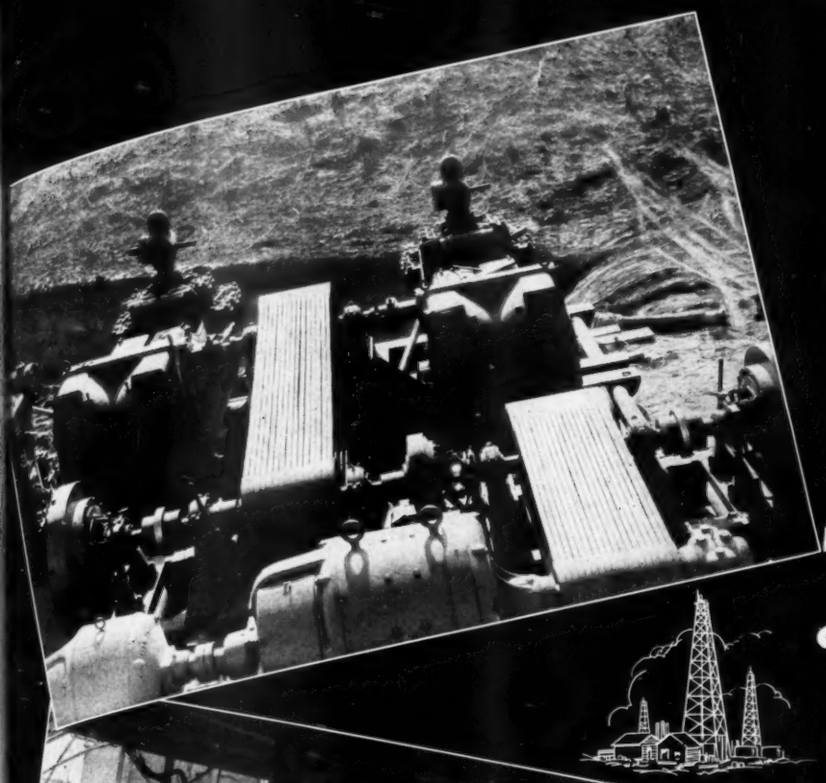
When the tractor type, gasoline-powered tractors were first developed 20 years ago the oil industry found a solution to one of its major field problems, that of transportation. It was the first application of this type of tractor, a fleet of "caterpillars" that hauled wagon trainloads of supplies for the Los Angeles aqueduct in the heart of the Mohave desert, that attracted the attention of the oil-producing industry. It was viewed as a solution to a difficult problem. A machine with plenty of power, that laid its own tracks, scoffing at footings and distances that had brought death and exhaustion to struggling mule teams, undoubtedly could be used successfully in the petroleum industry. Since that time these track-type tractors have been the truck horses of the oil fields. Today they are found everywhere, and perform many tasks other than simple transportation. Many of them are Diesel powered.

These tractors range in size from 95 hp. to 25 hp. for hauling units. Equipped with winches, sidebooms, or bulldozers, they are used for handling heavy timbers, pulling and running rods and tubing, erection of derricks, etc. They are employed also in bailing and cleaning wells, operating drilling rigs of the portable type, moving the entire drilling rig to new locations, shunting cars, laying pipe lines, ditching, building slush ponds and fire lines, and a hundred other tasks. A tractor-type welding unit also has been developed for pipe-line welding work. Auto patrols and graders also are used extensively in road construction work and

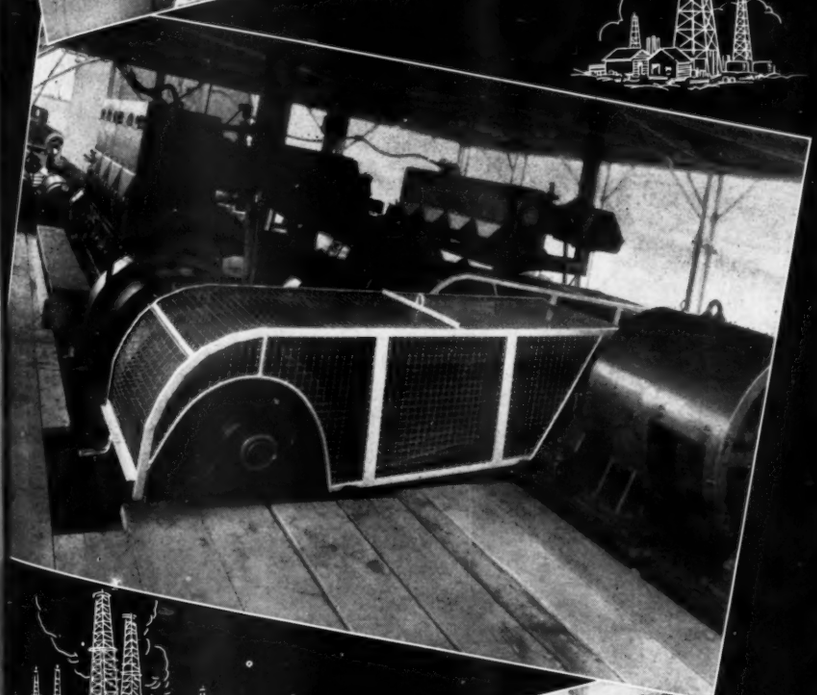
Fig. 1 (left)—Diesel tractors equipped with sidebooms aiding in the construction of a pipe line

Fig. 2 (below)—Diesel tractor operating a winch on a lease in the Oklahoma City field









# OIL FIELD Clutches FOR OIL FIELD Diesels

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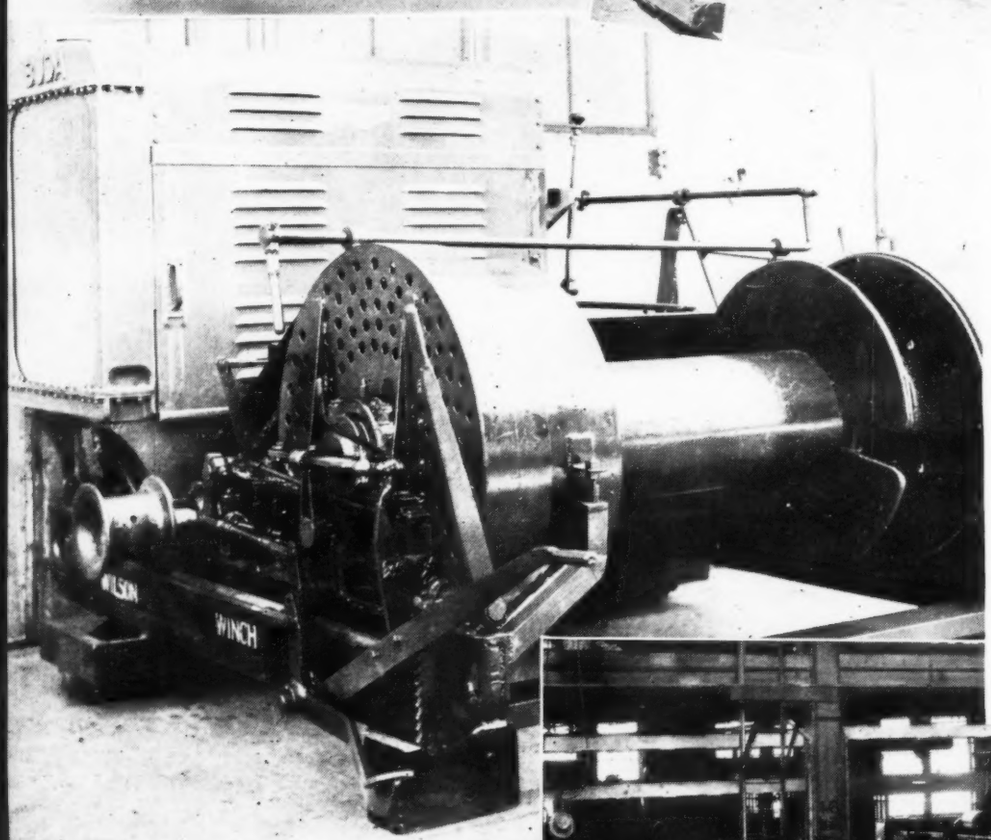
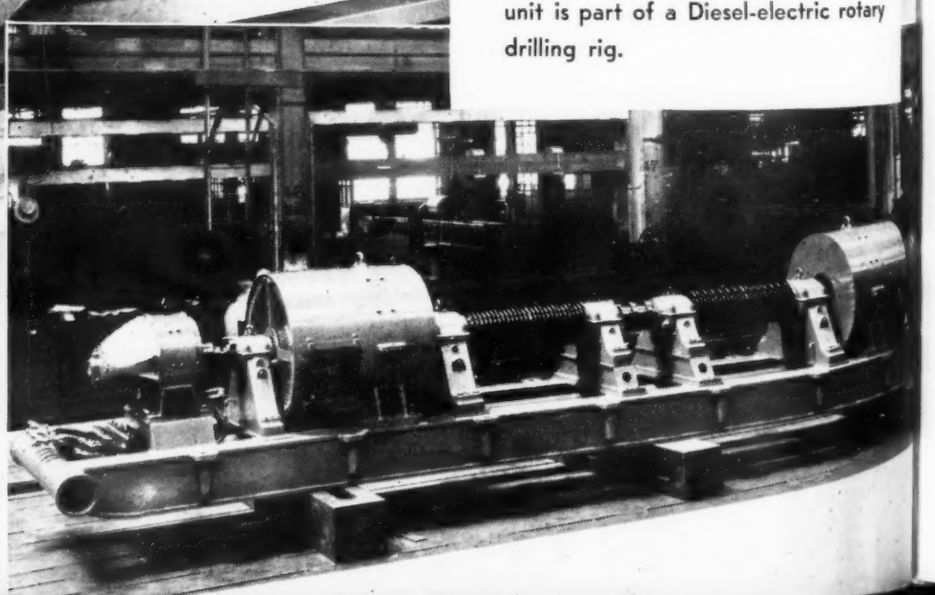
TWIN DISC CLUTCHES



Upper Left—Diesel tractor equipped with winch engaged in well-pulling operations.

Upper Right—Diesel engines driving rotary and drawworks on a well in West Texas.

Left Center—Diesel-powered pulling machine engaged in well-pulling operations in the Gulf Coast.

Lower Right—Generators and exciters mounted as a unit on steel skids. This unit is part of a Diesel-electric rotary drilling rig.

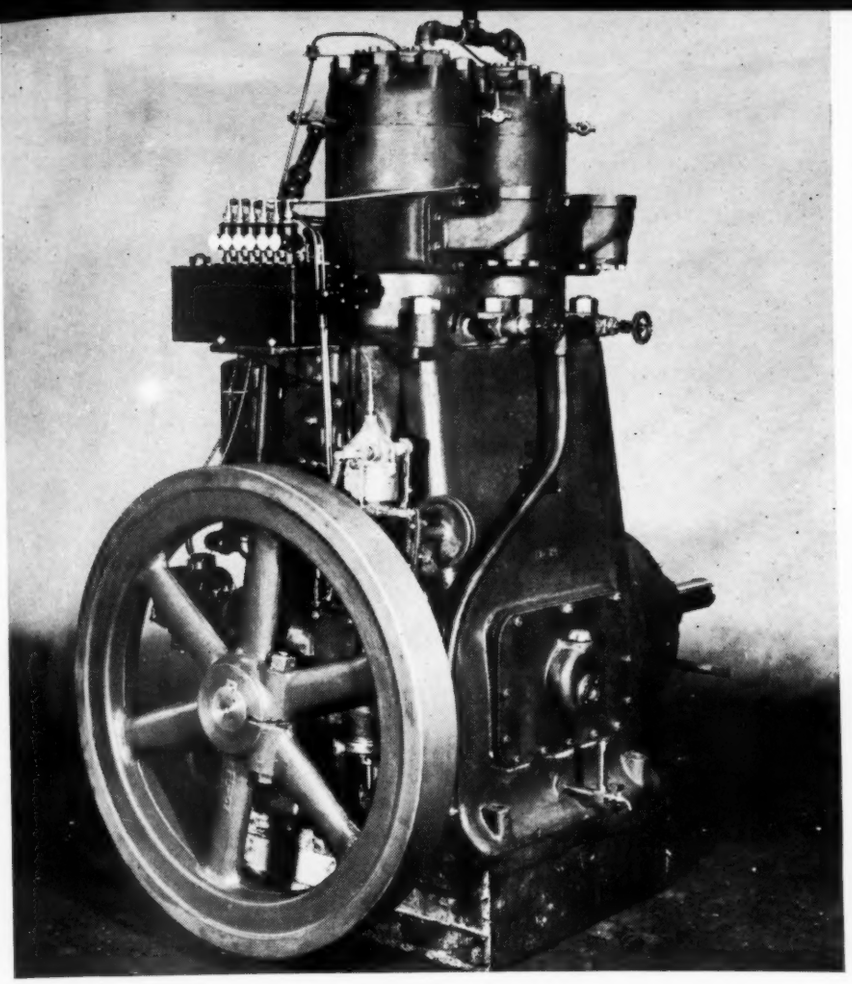


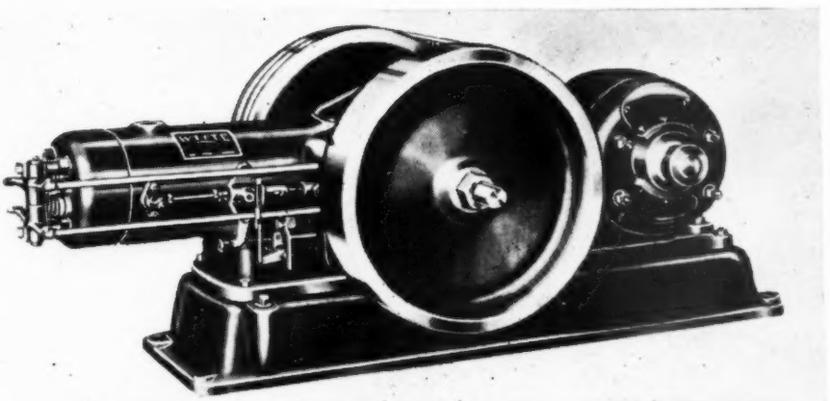
Fig. 3. (Left)—Typical vertical engine of the rugged type designed for oilfield service

hours worked is 14,000, almost all consumed in winch work. Approximately two gal. of fuel per hour are consumed by the engine and the working schedule is 24 hours per day. With more than 14,000 hours of service, it is reported that the upkeep cost has been 6.99 cents an hour.

In the oilfields of Southwest Texas, a unit equipped with this type of Diesel engine is in constant use. It is employed to drive a rotary drilling rig. Another engine operates a mud pump, and a third Diesel is used to operate a generator for lights and auxiliaries. The wells are drilled to 2000-3000 ft. in depth. The fuel cost is asserted to be 80 cents a day.

In Fig. 3 is shown a typical engine

Fig. 4 (Below)—Recently developed unit suitable for many power purposes, such as lighting, heavy trucks and tractors, hoisting, etc.



maintenance of roads in the oil fields.

Fig. 1 shows Diesel tractors equipped with sidebooms aiding in the construction of a 22-in. pipe line from Indianapolis to Detroit. Fig. 2 shows a similar outfit operating a winch on a lease in the Oklahoma City field. With this equipment 6800 ft. of tubing can be pulled from and run back in the well in eight hours at a fuel cost of 60 cents per day.

Diesel-powered tractors are also employed for hauling heavy boilers and other machinery supported on oil field trailers. Tractors equipped with a boom and a winch are employed for handling the equipment off and on the trailer and placing it in the field, for erection and dismantling, as well as operation, at the well, including pulling tubing and other such jobs.

Another application in the Oklahoma City field is a Diesel track-type tractor equipped with Cardwell winch and used to pull 2½-in. upset tubing at the rate of 90 ft. per minute from a depth of 6300 feet.

A Diesel tractor, equipped with an oilfield winch, was put in service in January, 1934. The equipment has been in almost constant service since. A conservative estimate of the number of

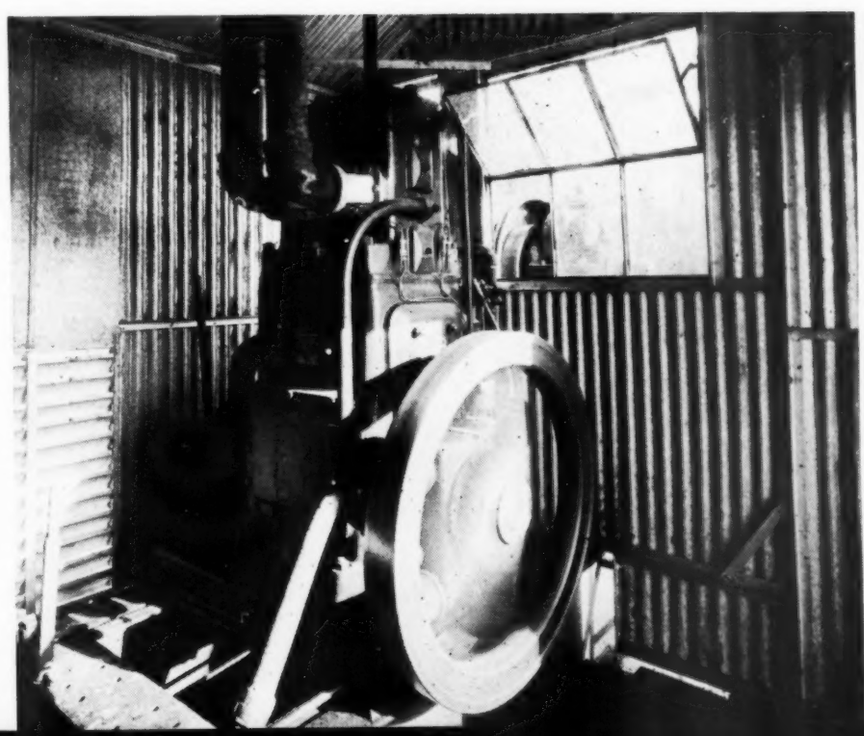


Fig. 5. Vertical medium-speed pumping engine

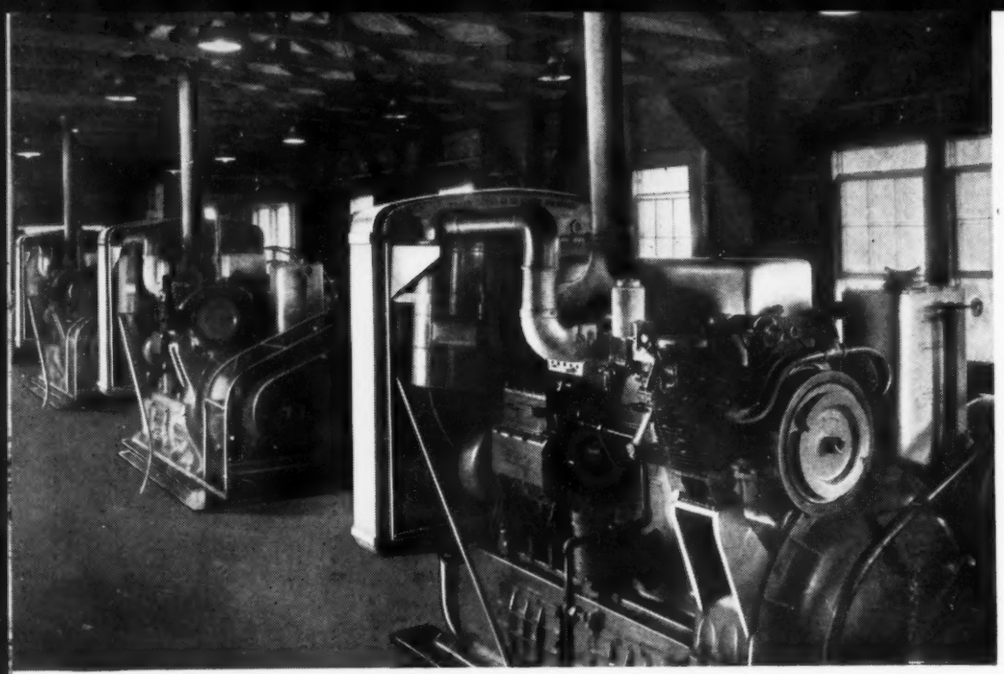


Fig. 6—Four 120-hp. Diesel engines providing power in a Louisiana pipe line station.

of the rugged type developed to withstand oilfield service in such applications as pumping. This is the twin-vertical type 2-cycle engine designed for heavy service and powerful well drive. The engine has a 7½-in. cylinder by 10-in. stroke and is rated at 44 hp. at 400 r.p.m., as a full Diesel, and convertible to gas with a 9-in. cylinder rated at 67 hp. at 400 r.p.m. The die-forged crankshaft operates in Timken bearings, as does the auxiliary drive and the water pumpshaft. The engine is the crosshead type with two bronze shoes, a full-size wrist-pin replaceable bushing of bronze. The lubrication is splash to all main parts, flood lubrication to the auxiliary drive, and force-feed to the cylinders. The Bosch injection system is used when operating as a Diesel engine, and a Scintilla magneto when operating as a gas engine. The engines are constructed to the same standards of design as the single and twin horizontal types. These horizontal engines are extensively employed for well pumping. They are made in two sizes, 13 by 18-in. and 14 by 18-in., are convertible to gas and are equipped with the same auxiliaries as the vertical type illustrated in Fig. 3.

Another vertical medium-speed pumping engine that has been developed for oilfield service is shown in Fig. 5. The engine is the 2-cycle type, either gas or Diesel, and is of the crosshead construction. This engine has a die-forged crankshaft equipped with Timken bearings. The engine has a 7½-in. by 9-in. stroke and develops 40 hp. at 400 revolutions per minute. The

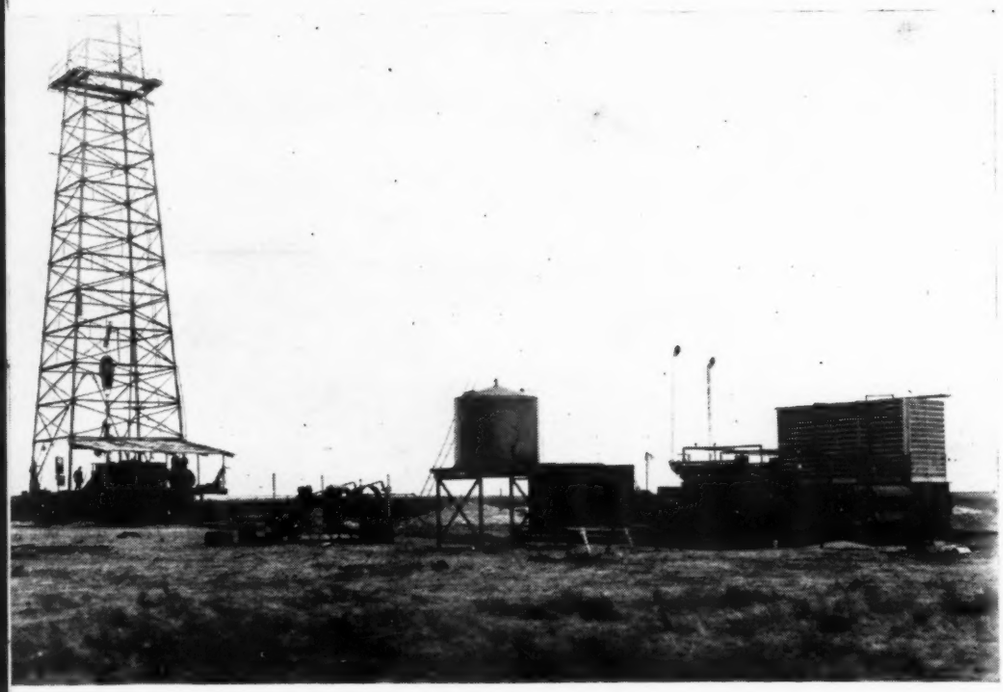
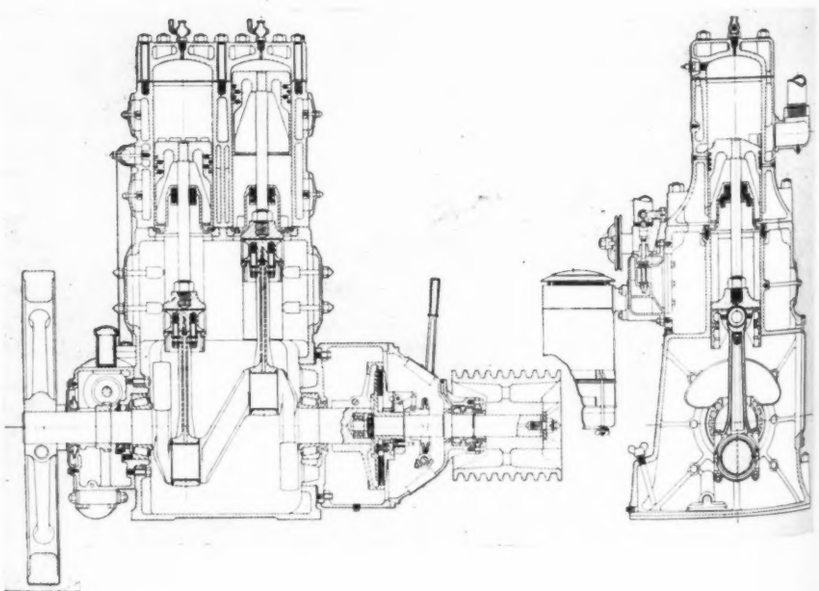


Fig. 7 (Above)—Drilling rig powered with Diesel engines as primary source of power—note water-cooling tower—engines are also equipped with air filters

Fig. 8 (Right)—Cross-section showing all the details in a 2-cycle internal combustion engine of medium size



# Introduced a Year Ago . . . this new PISTON RING has been widely acclaimed in Diesel Service

## *Reduces Liner Wear . . . Reduces Ring Wear . . . Stops Blow-By . . . Eliminates Oil Pumping*

This new Piston Ring achievement was designed and developed by American Hammered Piston Ring engineers and metallurgists scarcely a year ago. It is the result of long research aimed at improving the life of piston rings by using a combination of materials. Today, its successful operation in high speed Diesels for the U. S. Navy submarine engines, locomotive Diesels and many other Diesel applications, has been definitely proved, as well as in super-heated steam locomotives where these rings were originally introduced.

At left below is shown this new American Combination Cast Iron and Bronze Ring which, from actual service records, has given four to five times the life of ordinary cast iron rings. It polishes cylinders, prevents scuffing and scoring and greatly increases the life of both rings and liners.

In middle below is the Step Seal Ring that goes far to prevent blow-by in Diesel and other internal combustion engine service. The Scraper Drain Oil Ring, at right below, is usually installed in the groove farthest removed from piston head. It rides over the oil film on the up stroke and scrapes effectively on the down stroke.

The illustration at right shows these three types of American Hammered Piston Rings used in one assembly and strongly recommended for greatest efficiency and economy.

**American Hammered Piston Ring Co.**

*Division of The Bartlett Hayward Company*

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**Baltimore, Maryland, U. S. A.**

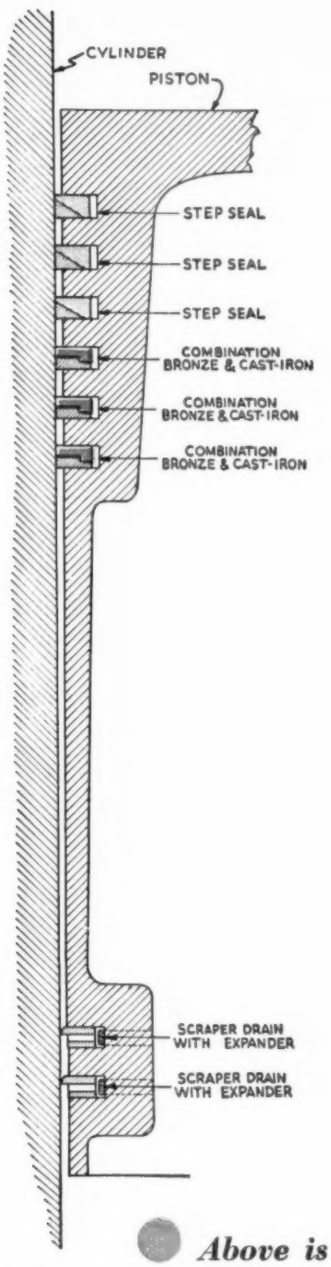
Patent No. 2,035,435

**American Combination Cast Iron and Bronze Piston Ring**

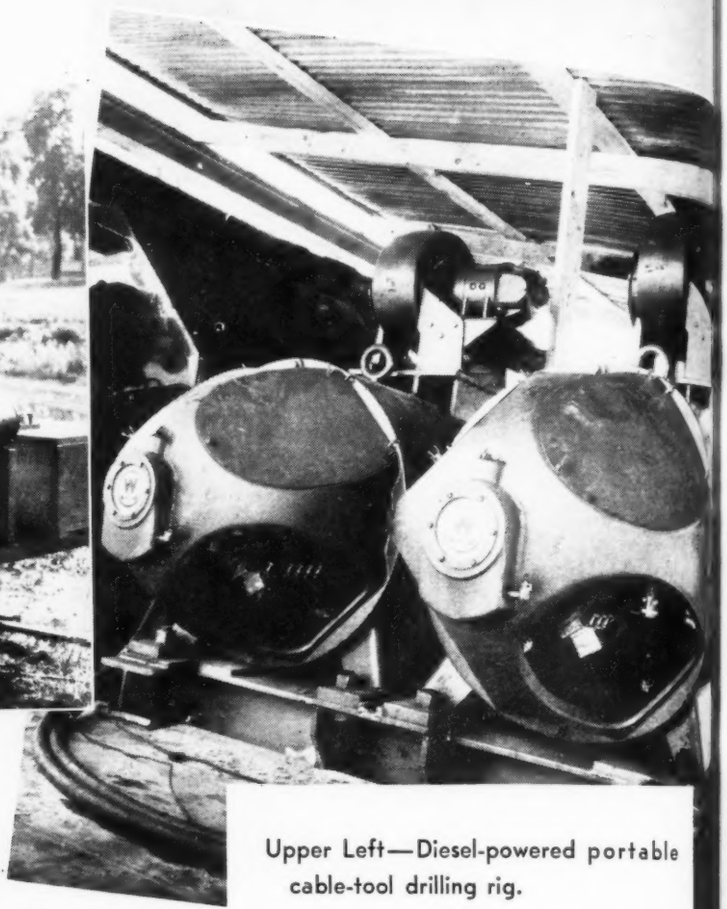
Patent Nos. 1,269,409—1,756,905—1,930,857

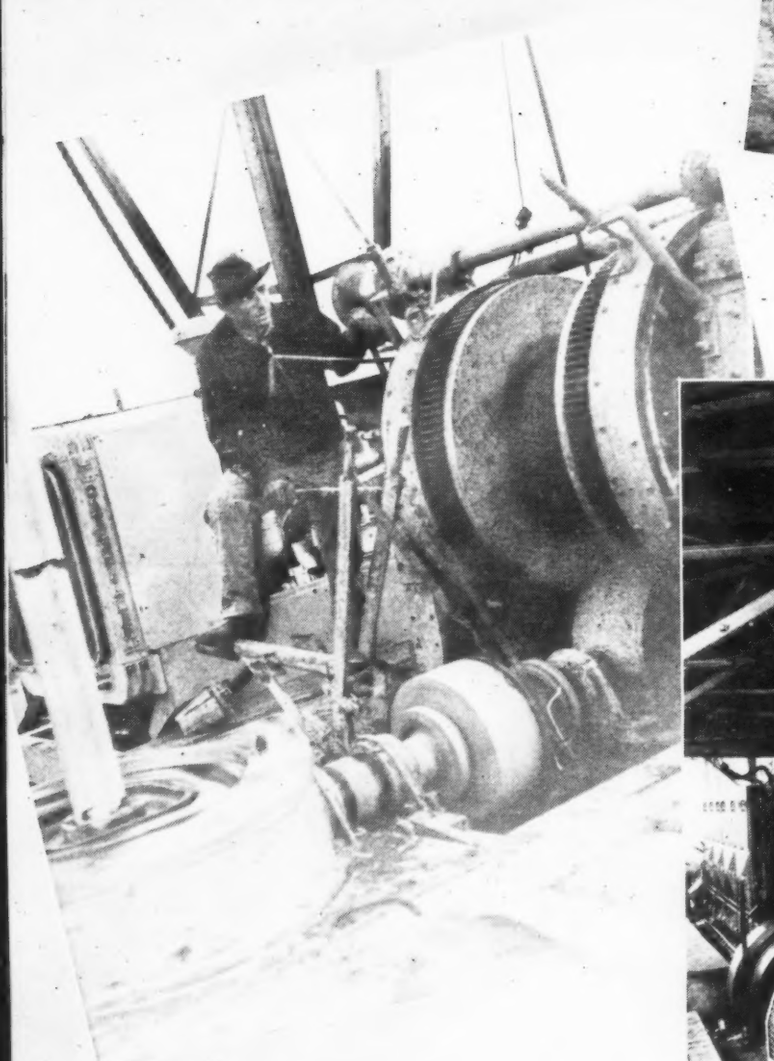
**American Hammered Step Seal Ring**

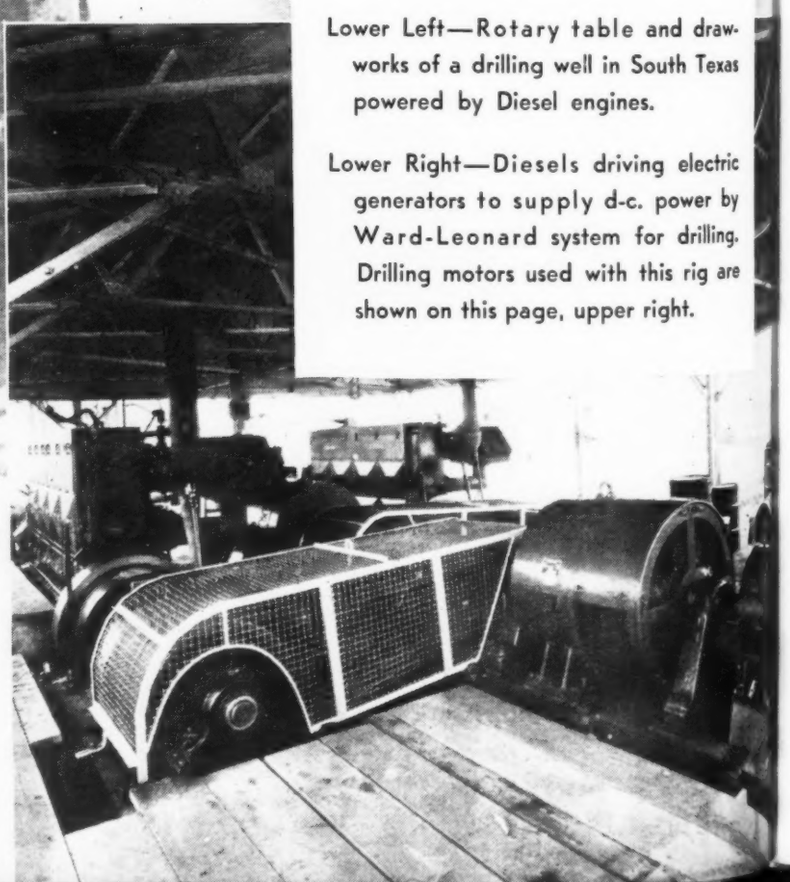
**American Hammered Scraper Drain Oil Ring**




***Above is suggested an assembly for Diesel Service***







Upper Left—Diesel-powered portable cable-tool drilling rig.

Upper Right—Electric drilling motors using d-c. power on an electric drilling rig using Diesel engines as a primary source of power.

Lower Left—Rotary table and draw-works of a drilling well in South Texas powered by Diesel engines.

Lower Right—Diesels driving electric generators to supply d-c. power by Ward-Leonard system for drilling. Drilling motors used with this rig are shown on this page, upper right.

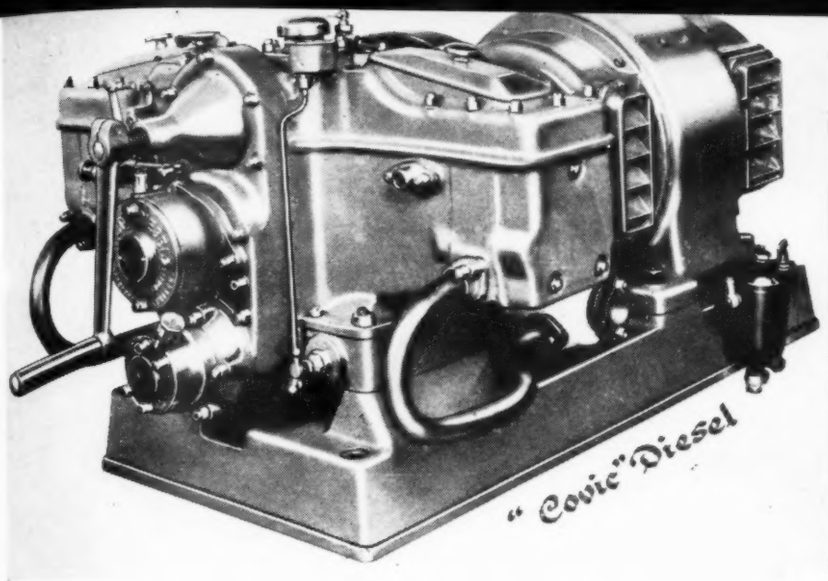



Fig. 9. A closed-type power unit, fully equipped and self-contained

and down time for repairs. Increasing the reliability of operation under hazardous and unfavorable conditions is the object of the designer of Diesel prime movers for oilfield applications. The successful and wide adoption of Diesels in recent years in the petroleum industry is evidence that this object is being achieved.

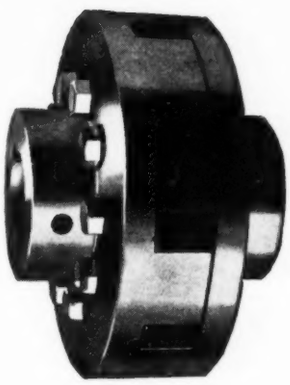
lubricating system is of the pressure type, the oil passing through a filter, a drilled crankshaft, and drilled connecting rods. The connecting rods, as well as the shaft, are die-forged and drilled for pressure lubrication.

These new engines are all equipped with air filters, built-in oil pump and lubricating oil filter, a built-in water pump, can be equipped with a radiator for a closed cooling system, have counter-balanced crankshafts, constant- or variable-speed governors, and air-starting systems. Clutch drives are used when required, or straight pulleys and flywheel drives can be provided. The engines described are among the latest developed and so far are the result of the demand for a pumping engine of this size.

Diesel power units of the completely equipped and self-contained type are making their appearance in many miscellaneous applications in the oilfields. Shown in Fig. 4 is a new development suitable for many power purposes, such as lighting, heavy trucks and tractors, hoisting, etc. This engine is a 6-cylinder 707-cu. in. open-type Diesel power unit driving a generator by means of a texrope drive. This is late development in the high-speed industrial full-Diesel engines. Such an engine has many applications in the petroleum industry, and several makes and designs have been put into use within recent months. A closed-type power unit is shown in Fig. 9, fully equipped and self-contained, including a clutch.

The increasing need for sturdy and economical power units to meet the severe service demanded in the oilfields is resulting in the further development and application of high-speed, medium-speed, and heavy-duty Diesel engines. Non-corrosive metal is being introduced to protect the engines using unsuitable fuels. Roller bearing designs are worked out to reduce maintenance

L-R everlasting FLEXIBLE COUPLING NON-LUBRICATED



Type "P"
Free floating interchangeable load cushions. No metal-to-metal contact. 2" to 14" bores.

For All Drives and All Machines

L-R Couplings "eat up" shock loads—have visible load cushions—prevent shut-downs of equipment—their low first cost and high efficiency assure economy of operation. No servicing required.

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L-R Couplings have proved their worth in Diesel service. Type WFR can be set practically within the flywheel, conserving space and power. Capacities 5,000 to 1,500,000 inch pounds.

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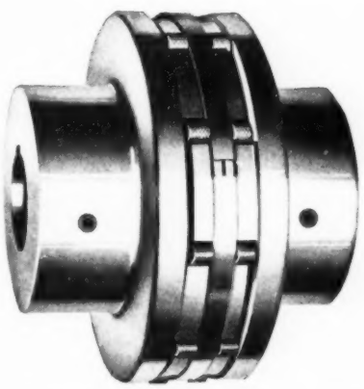
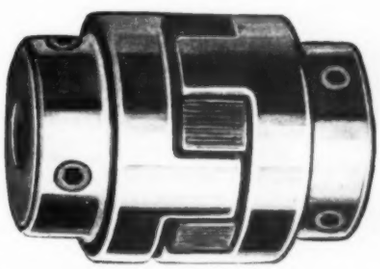


Type "W" Spiral steel spring holds free floating load cushions securely in place. 2 13/16" to 14" bores.



Type "I-A" A deservedly popular, trouble-free coupling for small units. Simple—compact. 3/16" to 2¾" bores.

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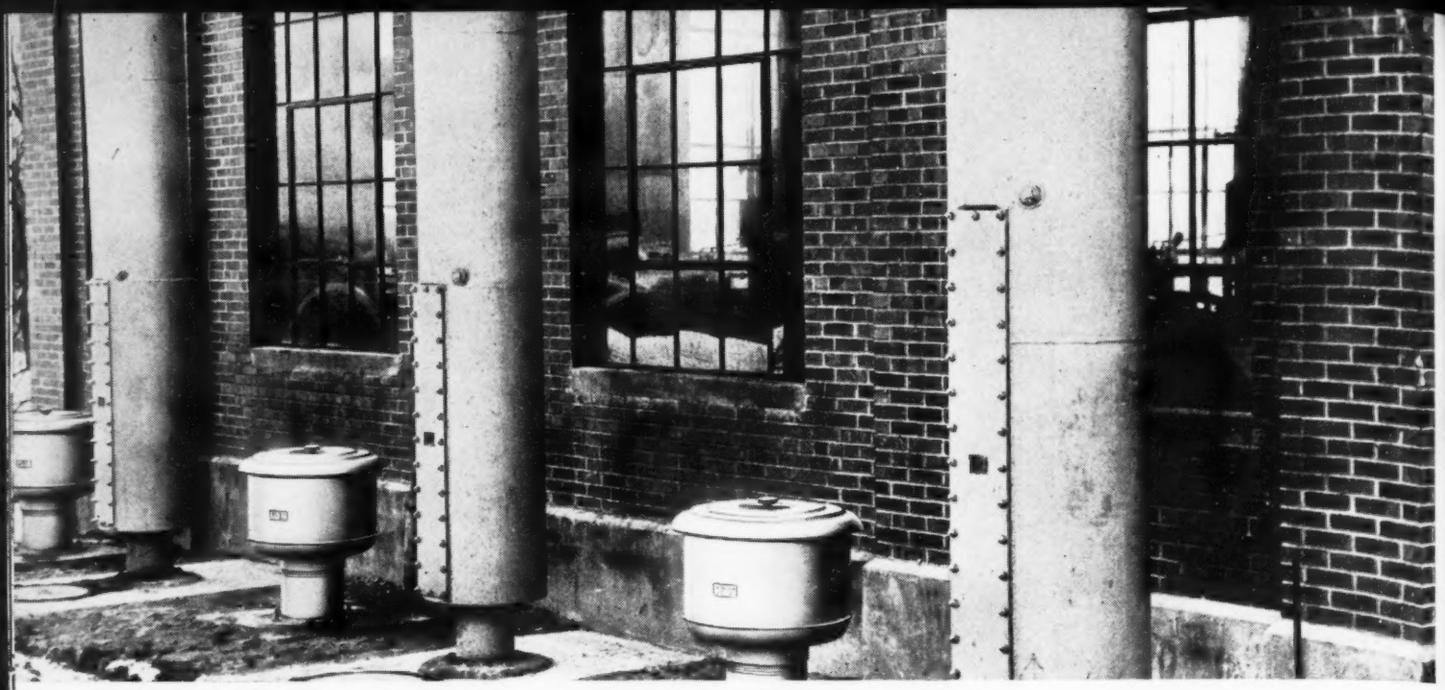

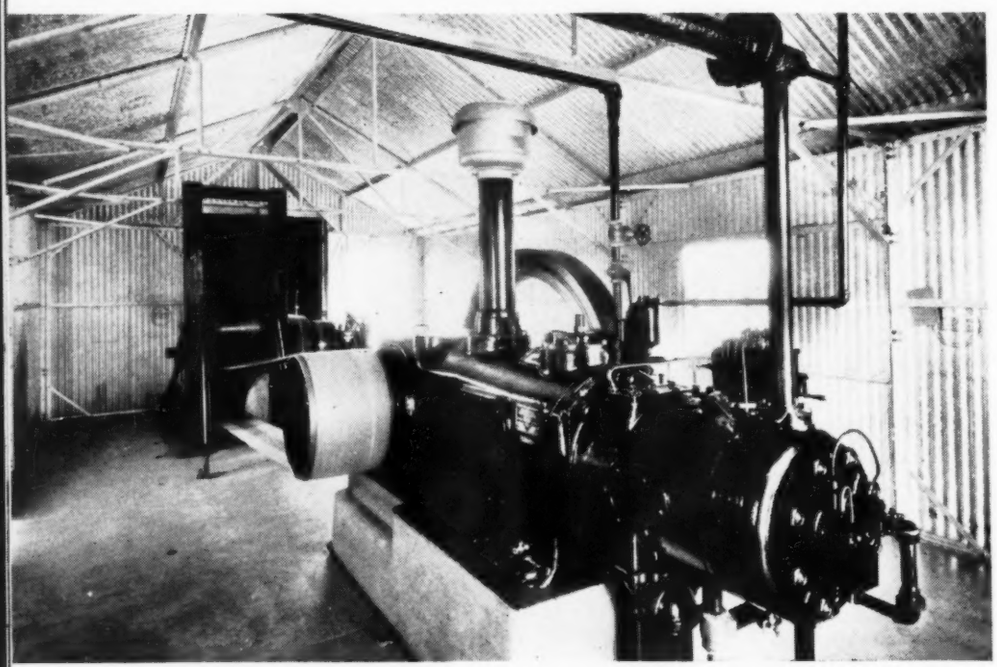

**Fig. 1 (above)—Installation of air filters on engines and compressors**
**Fig. 2 (left)—Air filter on an engine used on a pumping well**

# Importance of Clean Air and Water in Diesel Engines

## Benefits of Filtered Air in Diesel Engine Operation are Best Appreciated Through a Knowledge of the Destructive Effects of Unfiltered Air—Clean Water in Engine Jackets Essential for Efficient Operation

ALTHOUGH air filters are now generally used on all types of new engines and compressors in the oil fields, a somewhat limited knowledge and appreciation of the importance of clean air in the Diesel engine among operators is to be noted, particularly in drilling operations. Due to this fact, much equipment is being operated without dust equipment, or inadequate attention is given to protection of the engine through the use of suitable air filters. This is the result of the lack of information concerning the volume of air an engine and compressor handles and the extent of dust or air pollution prevalent in most localities where such engines are operated.

It might be said that the crux of the entire question and the resultant lack of appreciation of the importance of air filtering lie almost entirely in the erroneous belief that the air in the atmosphere contains no appreciable volume of dust. Dust is a solid material in a finely divided state. Some dust particles are small and sufficiently light in weight to be borne, even in still air, for some distance before settling. Somewhat larger particles of sand and grit are picked up by moderate winds, and still larger particles are moved by clouds formed or created by tornadoes and winds of high velocity during drought periods.

The protection of exterior working parts of internal combustion engines and air compressors that are housed in buildings is a problem of dust control through air-cleaning or air-conditioning. We are more particularly concerned, however, with dust that is "breathed" or drawn through the intake manifold into the cylinders of engines and compressors. Piston, piston ring manufacturers, and manufacturers of engines are often called upon to make adjustments on which it is asserted by the operator that rapid wear was due to soft or inferior metals. While there are other factors that could affect the life of an engine, premature wear in the modern motor can be traced in most instances directly to inadequate dust protection or no protection at all.

Dearborn

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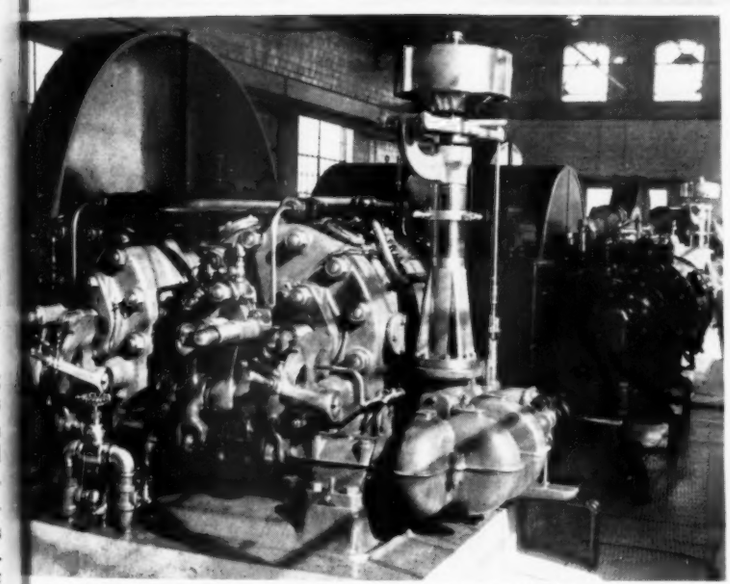

# COOLING WATER TREATMENT

Condition of the cooling water is a vital consideration in any Diesel plant. Dearborn Cooling Water Treatment and Chemical Engineering Service will solve this problem in your plant, eliminating scale deposits and corrosive action.

Dearborn supplies powdered treating chemicals for use through central treating tanks and Dearborn Tannin Brick No. 2 for direct application to system water. When immediate removal of old scale is required, Dearborn Special Formula No. 134 is the safe scale solvent.

"Old Faithful," shown here, has operated 69,220 hours, using Dearborn Cooling Water Treatment, and was still on the line at last reports. Previous to the use of Dearborn Treatment it ran only 1,500 hours between cleanings.

Dearborn Service Men and Chemical Engineers will gladly make survey and recommendations for the most economical solution of the cooling water problem in your plant.

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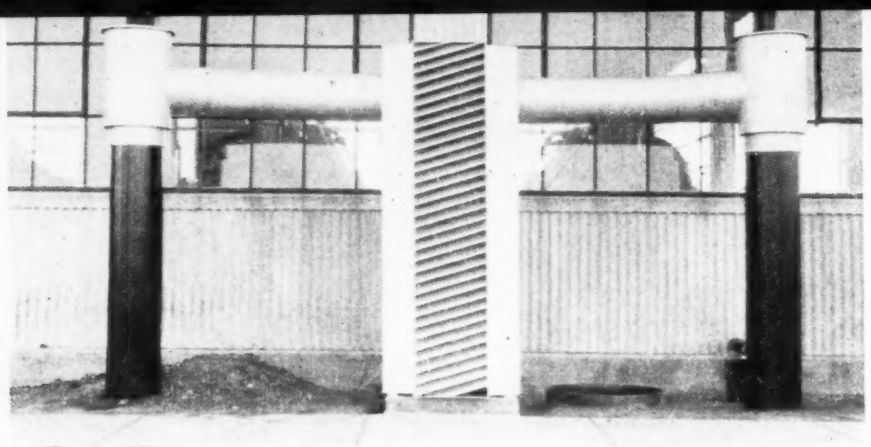


**Fig. 3. Dry screen or strainer type air filter for compressor plants**

Cylinders, pistons, and rings are manufactured with precision, and assembled to provide compression in a combustion chamber or cylinder head. In order to guard against normal wear and heat caused by friction, engines and compressor piston rings slide in a film of lubricating oil. The protection thus far is adequate as long as the lubricant is maintained clean and viscous. But dust particles drawn into the cylinders with each air intake stroke of the piston work their way between the cylinder wall and the rings, mix with the lubricant and form an abrasive substance that gradually or in extraordinary cases, rapidly wear away these reciprocating parts; abrasives are carried to all internal parts of the engine lubricated by this oil. In order to appreciate what one grain of dust per 1000 cu. ft. means to an engine, it is necessary to take a case in point. As an example, a 500-hp., 2-cycle, engine with a displacement of 3500 cu. ft. per minute, a dust concentration of only one grain per 1000 cu. ft., will take in three and one-half grains of dust per minute along with the fuel air. Operating ten hours per day, the engine will take in two and two-tenths lb. of dust every week, or approximately 100 lb. a year.

Diesel and gas engines and compressors represent a large investment in the petroleum industry. Operating engineers are interested in lowering the depreciation and maintenance cost and lengthening the life of this equipment. In the face of the facts just cited, one of the most practical means for effecting these economies is the filtering of the air that goes to the cylinders. This is done by employing an air filter that will remove a great percentage of dust particles of all sizes at the air intake. An example of the reduction in wear that can be realized is afforded by 35 engines on a pipe line system from Texas to Chicago. These engines had been equipped with air filters prior to dust storms. Engine wear was reduced from .006 of an inch to .001 of an inch per 1000 engine hours. Filters were replaced every three hours during these storms, catching more than seven lb. of dust per 20-in. by 25-in. air cell.

Although there may not be a great volume of dust in a few cu. ft. of air under ideal circumstances, there is dust in all air and over a given period of operation, say of a 1000-hp. engine handling 1,920,000 cu. ft. of air each ten hours, the dust that passes through or into an engine is more than enough to take its toll in damage to the equipment. Further, it should be considered that operating engines and compressors in the field, in drilling operations, in pumping plants, and in proximity to construction work where the dust content of the air is obviously considerably higher than in sections where there is less of such activity, is in most cases ruinous and dangerous to the equipment.

In Fig. 1 is shown the layout, exterior view, of air filters for the protection of pumping station engines and compressors.

Practically all tractor, truck, and field engines are so equipped today, because rapid wear is experienced in the absence of such protection. It is equally important to protect engines on drilling locations.

These engines operate under dusty conditions, where lubricating oil is easily contaminated. In many sections oil wells are being drilled under similar conditions. The dusty air is breathed into the engine, and, unless adequate equipment is used, excessive and rapid wear in the cylinders will result.

Three general classes of air filters are in use at the present time: (1) The dry screen or strainer type filter; (2) the oil bath or splash type filter; and (3) the adhesive coated or impingement type filter. Many types of filters are on the market differing in design and construction, but these three general types cover them all in principle.

The filtering medium in the dry screen or strainer type filter, is of fabric or paper that is held in place by steel frames or grilles.

In the oil bath or splash type filter the air is made to pass through a bath or a spray of oil and another filtering medium of low density that is impregnated or coated during operation. The dust particles are washed down with the

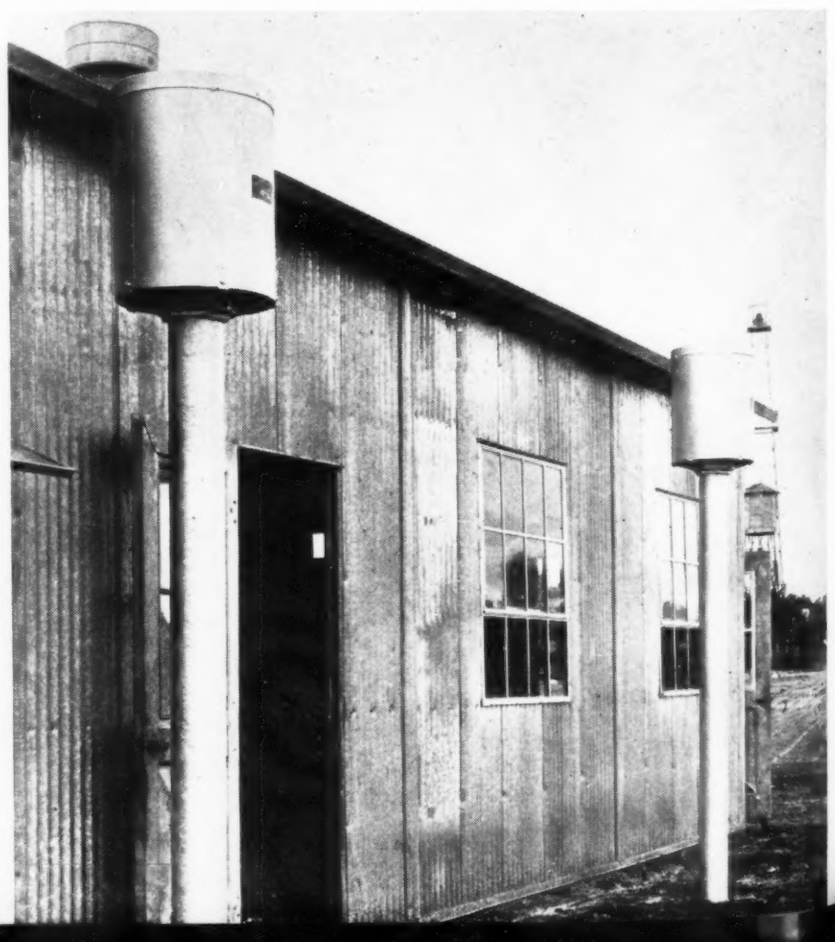


**Fig. 4. Dry screen or strainer type filters on the intake to two engines at a pipe line station in Oklahoma. These are weatherproof outside installations**

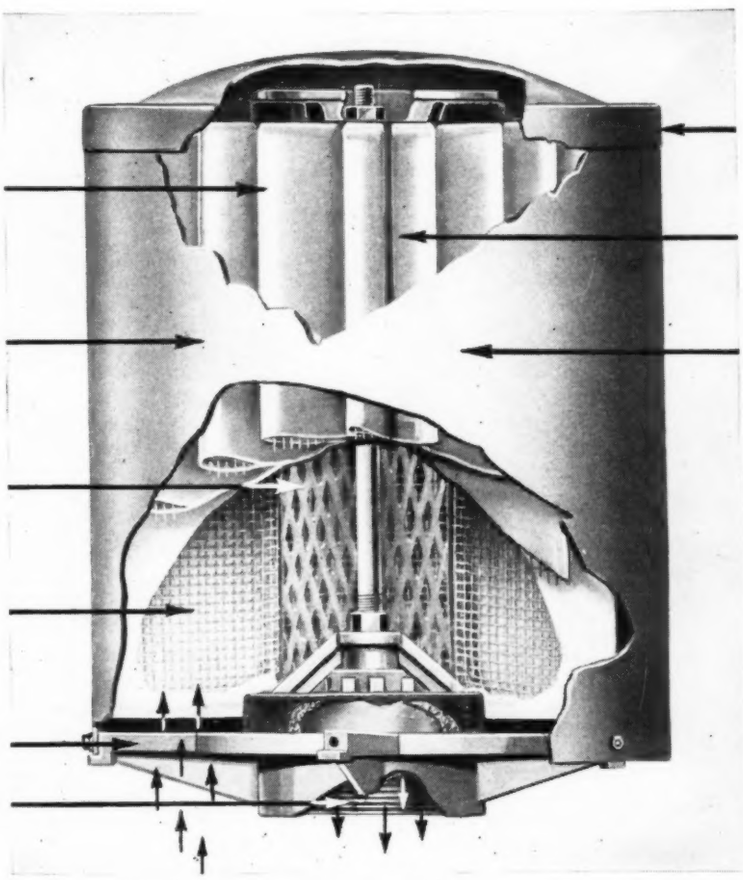
*(Photo of Protectometer installation by courtesy Stayneu Filter Corporation)*

# *The finest* AIR FILTER *ever made*

# PROTECTOMOTOR

MODEL "D"

***for pulsating intake on diesels, gas and gasoline engines, compressors, etc.***




Model "CPH"
Air Line Filter

For air transmission line filtration to pneumatic hoists, air hammers, drills, riveting guns, paint sprayers, etc., etc. Contains both exclusive Protectomotor features.

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Resists pulsation better than any known form, having no broad, flat surfaces to vibrate. Permits large area of filtering medium to occupy a small space. This means low resistance to air flow, and long filter life. No other filter has the Circular Fin Construction.

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A positive dry filtration medium, exclusive in Protectomotors. Feltex in the Circular Fin Construction produces a long lasting, easily cleaned and highly efficient filter. No oil necessary. Clean, dry air is guaranteed.

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AIR FILTERS

MODELS FOR AIR CONDITIONING AND DUST RECOVERY ALSO MANUFACTURED BY STAYNEW.

**STAYNEW FILTER CORP., 2 LEIGHTON AVE., ROCHESTER, N. Y.**

Fig. 5. Oilbath or splash type filter

oil, and the other filtering medium is kept clean and sufficiently coated to catch the dust particles. In the oil bath type the intake orifice of the filter is reduced in size to induce air into the chamber at high velocity, thus agitating the oil and setting up a spray through which the air passes. In the splash type, the oil is splashed against the sides of a circular chamber by centrifugal force. The air passes through the spray of oil and another filtering medium and is cleaned.

The adhesive-coated or impingement type filter consists of an adhesive-coated fibrous mass that is confined on the intake and discharge faces by metal meshing or grilles. These packs, suitably housed in frame units and protected with weather louvers, are attached to the air intake pipe of the engine.

### Importance of Clean Water

Most natural waters used for cooling purposes contain a sufficient amount of temporary hardness to cause the precipitation of calcium and magnesium carbonates as scale deposits when the temperature of the water is increased to any extent. Natural waters also often contain considerable amounts of soluble sodium salts that concentrate in a cooling system due to loss of water by evaporation. The concentration of these salts is likely to cause corrosion, especially in view of the fact that in a cooling system of the re-circulating type the water is continually being aerated and is, therefore, always saturated with dissolved oxygen.

In a cooling system of the enclosed type the loss of water due to evaporation is not large and, therefore, concentration in this case is not rapid. On the other hand, the external cooling water, used in conjunction with the cooling system through a heat exchanger, is subject to atmospheric conditions and must also be taken into consideration in the treating process.

If re-circulation is not provided, and if the cooling water goes to waste after it passes through the engines, very little, of course, can be done in the way of treatment, and, therefore, the following discussion is based upon the use of a cooling system of the re-circulating type.

The most satisfactory method for treating a cooling water supply for the prevention of scale deposits is to install a central treating tank for softening all make-up water before it is added to the system. In this case the hardness is reduced to one grain per gallon or less, and very little, if any, precipitation takes place when the temperature of the water is increased as it passes through the engine jackets.

In beginning the use of this treating system the spray pond, or reservoir, should be filled with treated water and the total hardness in the circulating water should not be allowed to exceed approximately 1½ grains per gal.

Fig. 6. Adhesive coated or impingement type filter with weather louvres. This filter contains viscous type cells

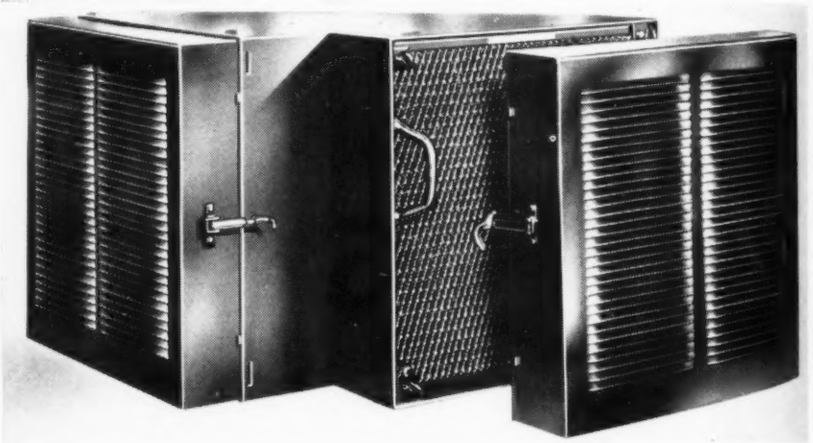


Fig. 7. Adhesive coated or impingement type filter. An American Annis wool felt dry type filter cell is employed in this installation

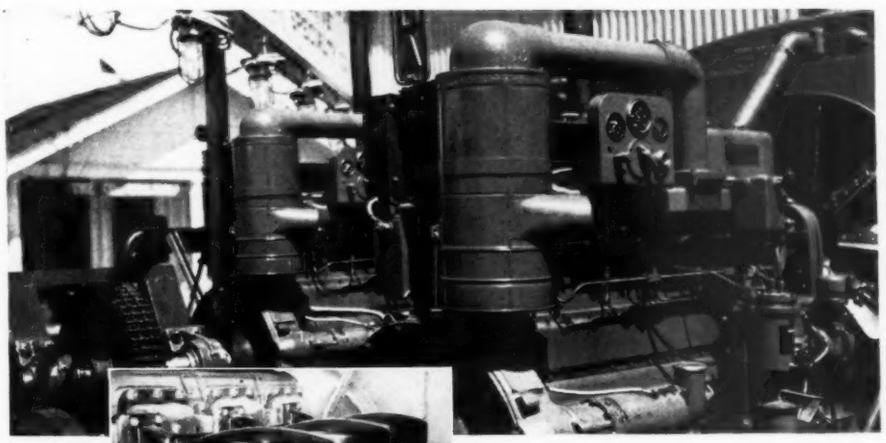
at any time. The concentration of dissolved solids, due to loss of water by evaporation, cannot, of course, be prevented and this makes it necessary to change the system water occasionally provided the concentration of sodium salts presents a corrosion problem, or provided it is not desirable to add a special dosage of treatment to the system water in order to reduce the hardness. In some cases where corrosion is severe it is necessary to add special treatments containing the proper inhibitors that have been found successful in this connection. Special treatments containing the required water-softening agents, together with special coagulants, are used through the central treating tanks and the dosage depends upon the raw water hardness. In plants where it is not convenient to use this method of treatment the water-softening chemicals can be added directly to the circulating system in proportion to the amount of raw make-up water added, although this method does not prove entirely satisfactory, due to the fact that all precipitation takes place in the circulating water with the formation of sludge, the amount depending upon the hardness of the raw water supply. Although the same degree of softening can be obtained by adding the treatment directly to the system water, the presence of suspended matter is likely to cause the formation of deposits unless a large reservoir is used where the suspended matter would have an opportunity to be partially settled out.

Another method also is frequently made use of when it is not practical to install central treating tanks. It is based upon the use of colloidal treatments directly in the system water that have no softening effect, but, on the other hand, tend to prevent the formation of scale by a physical rather than chemical action.

In waters where the original hardness is not excessive this type of treatment will produce entirely satisfactory results and has the particular advantage of requiring no water-treating apparatus and also requiring no chemical control. In the case of smaller cooling systems where it is not considered practical to treat the water by any of the above methods, the engine jackets and heads may be cleaned out periodically by the use of acid-type treatments that contain suitable inhibitors for preventing action on metals during the cleaning operation.

The treatment of cooling water in the larger Diesel engine plants is of sufficient importance to warrant consultation with a company that specializes in this type of work, or with a chemical engineering concern that has had experience along this line. It is important that the treatment used be based upon the analysis of the water supply and that frequent tests be made on both treated and circulating water for the purpose of determining whether the proper results are being obtained. The prevention of corrosion in the cooling system is a special consideration in all cases and must be handled accordingly.

There are many ways in which the reliability of the jacket water supply may be assured. A simple and effective method is to employ an overhead tank feeding the engine by gravity, the tank being kept full and overflowing by a circulating pump. Should there be pump failure, the water level in the overhead tank immediately will start to fall. This drop in level operates a warning bell or alarm, flashes a lamp, etc. An alarm can be installed in the discharge pipes from the engine jacket to signal when the water temperature becomes too high, which will prevent any accidents from careless manipulation of the valves when starting the system.

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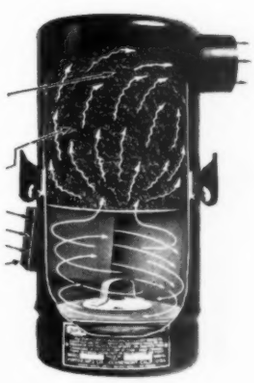

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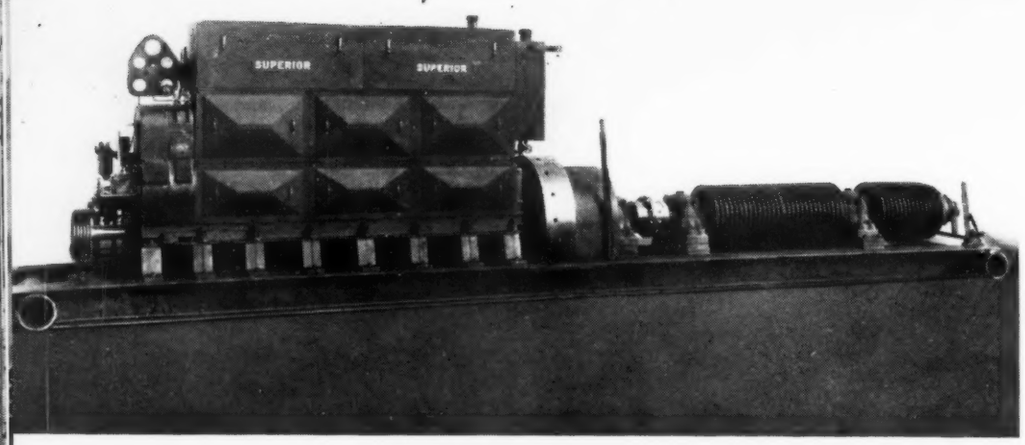


A 9 by 12 Diesel drilling engine, 350-hp., 600-r.p.m., 4-cycle, solid-injection type

**Efficient operation can be assured only if definite schedule of upkeep is followed**

# Repair and Maintenance of the Diesel Engine

THE importance of a fixed routine in the maintenance and repair of the Diesel engine cannot be overemphasized. The work of keeping a Diesel engine in good operating condition must be confined to a strict routine if the engine is to escape the ravages of abuse and neglect. Of course there is no general schedule of maintenance that can apply to all engines and applications, but a specific schedule can be adopted to serve a specific unit or application if the requirements of such an application are thoroughly understood.

The Diesel engine is not an independent unit, entirely self-contained, but has several distinct and separate auxiliary systems that control its economic possibilities. It is obvious that these auxiliary systems must be considered and adequately provided for at the time the engine is installed.

The inherent characteristics of each separate and specific type of Diesel engine application make a definite demand upon the equipment in the auxiliary systems. As an example, it may be shown that standard auxiliary equipment fails to control the corrosive properties of the cooling water, and not all fuel systems will handle the corrosive properties of some kinds of fuel oil. Modification of these systems is required to meet such conditions before a sensible maintenance plan can be worked out. It becomes essentially important, therefore, to know the physical limitations of these two factors when selecting and making an application of a Diesel engine.

It is not meant to infer that the Diesel plant is an intricate unit or system, but it is felt that there are numerous places that require careful and constant study of operating conditions. Through a schedule of regular maintenance and inspection and a study of records thus obtained it is possible to know the internal condition of the machine within fixed limits at all times. With this knowledge of reasonable working conditions and limitations, replacements, repairs, and adjustments can be made well in advance so as to eliminate aggravation and forestall difficulties in maintaining the reliability of the engine.

The importance of having an engineer in charge of Diesel equipment is becoming more appreciated. Service, output, and reasonable maintenance reach their most satisfactory conditions when placed under direct charge or supervision of a responsible engineer. It seems certain that if the Diesel equipment is provided with proper auxiliaries to meet the operating conditions of a particular application and placed directly under a competent head as operator and engineer, the general success of this type of engine will be much greater and more satisfactory.

In other words, after an engine is selected and the proper installation has been made, including those modern refinements that make up a Diesel operating unit, the proper inspection and maintenance schedule of the entire system is essential to obtaining low cost power that this type of engine makes possible.

And it must not be forgotten that the cost of making a proper layout and installing the proper refinements and auxiliaries is fully repaid by the subsequent operating savings and in addition the performance is greatly improved.

The process of maintenance comes under the head of cleaning, adjusting, reconditioning and renewing of various parts subject to wear and breakage. The nature and amount of equipment to carry out this maintenance work depends upon the engine and system of maintenance followed. Maintenance work differs only in the amount of reconditioning of the various parts of the engine and the auxiliaries carried out in the field. If a policy of little or no maintenance work in the field is to be followed,

Diesel tractor digging a slush pit in the field near Wellington, Kansas

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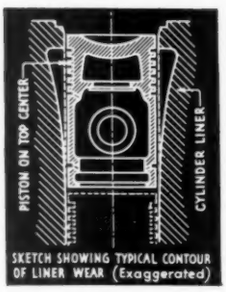


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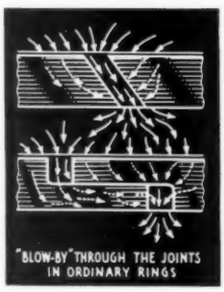


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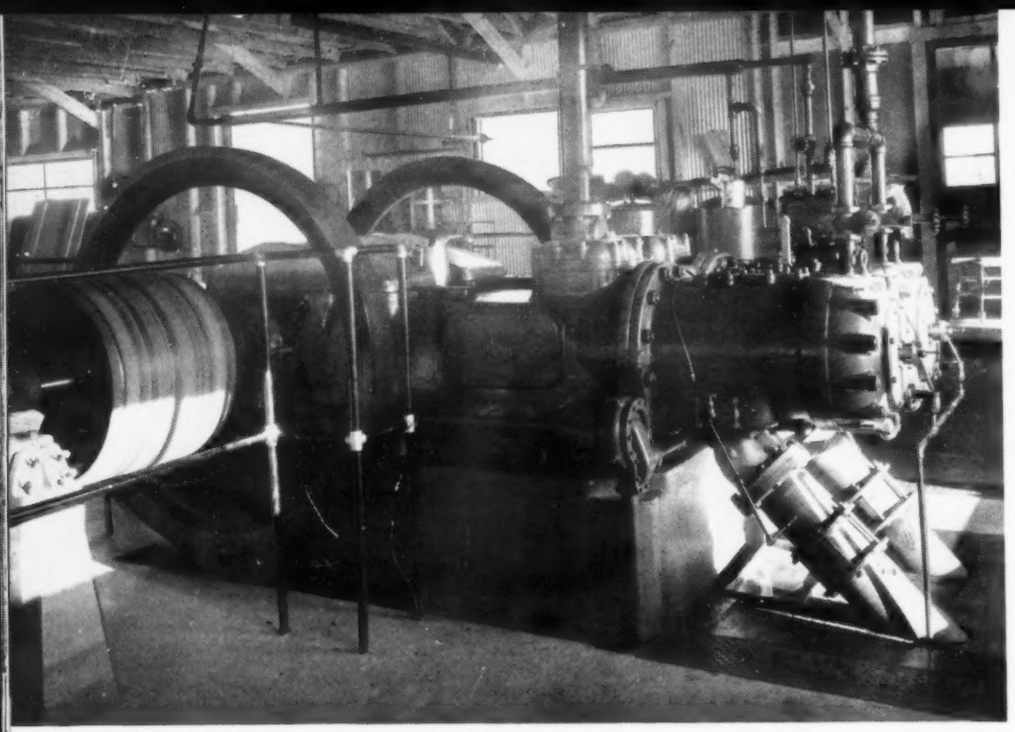


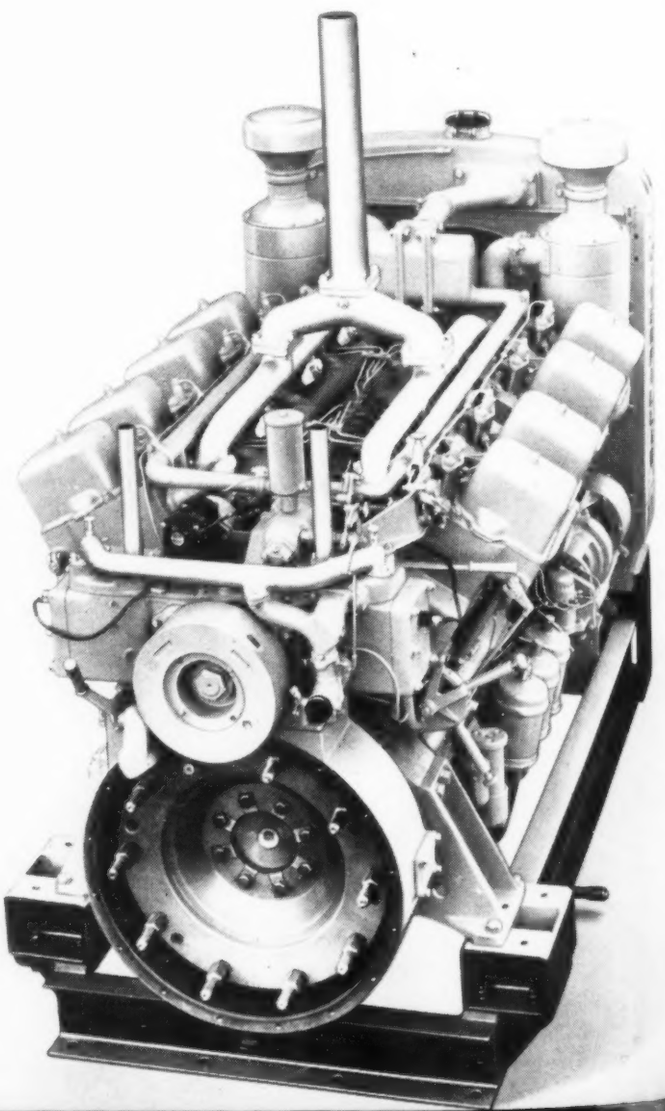
This engine, full Diesel twin cylinder, in a Kansas pipe line station, has been in service since September, 1933. It drives a 5-in. by 10-in. plunger line pump, delivering oil through a 6-in. line against 350 to 500 lb. pressure. Also an 8-in. by 10-in. suction pump is driven, as well as a small generator of about 10 hp.

only a small outlay for maintenance equipment is needed, but there will be the necessity of keeping a small stock of repair parts on hand. If a policy of extensive maintenance is established, a considerable amount of maintenance machinery must be provided, but there will be a smaller amount of spare parts required. Experience tends to indicate that a large outlay for maintenance equipment is not an economical asset where only a small plant or few Diesel engines are used, because the high cost of quality machinery necessary and the general lack of mechanical skill and appreciation of the accuracy of work of this kind on the part of some operators and Diesel engineers.

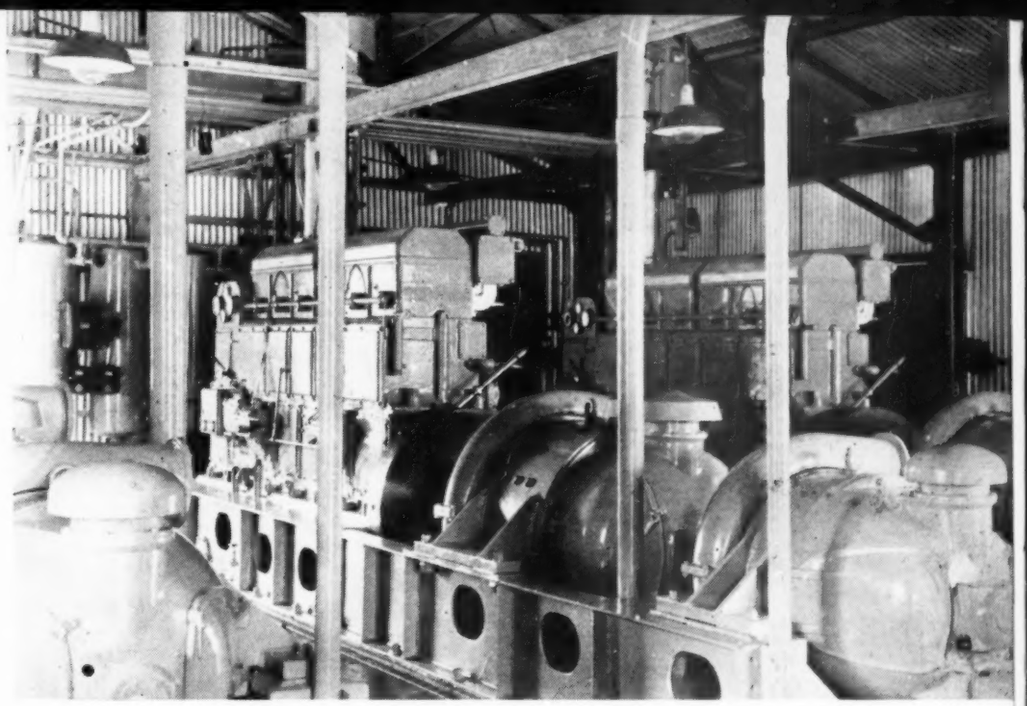
However, large plants such as pipe line pumping stations can show an economic advantage from the installation of a limited amount of good machine tools, however this advantage is retained only so long as the operating men in charge appreciate the limits of accuracy and quality requirements of Diesel replacement parts and have the skill and experience necessary to fabricate and fit such parts. Much additional knowledge and training added to that of the average Diesel operator is needed for this work.

In this connection an important requirement must be emphasized, that in the operation of Diesel equipment, we should know its past history and have such records as will make it possible to predict its future performance. And this can be done only within the limits of accuracy of the records, there records and instruments, if they are to be of any consequence, must have a known degree of accuracy. The quantity and type of records on the operation of a Diesel engine depend entirely on the personnel in charge of the plant and the policy established. In the last few years many Diesel operators are insisting upon such instruments as fuel-measuring devices, pressure indicators for power cylinders, thermometers, pyrometers, load output meters and sufficient micrometers and the like to measure accurately the wear of all parts of the engine.

With these instruments at hand and a definite system of established records, deficiencies of operation can be ascertained and the operating problems solved without loss of time and money.



Diesel with V-8 engine, the latter having the cylinder banks set at a 60-deg. angle, and develops 160 maximum b. hp. at a governed speed of 850 r.p.m.



Interior view of a power barge, showing three splash-proof generating units of 125 kw., 250 volts, and a 25-kw. auxiliary generator, driven by a 250-hp. Diesel engine. This barge is in Venezuela, South America, and supplies power for maritime drilling operations

Of course, the engineer in charge should be capable of doing maintenance work and supervising mechanical shop work, if such shops are maintained.

The need for lower operating cost and consequently lower power cost in the petroleum industry, due to economic conditions in the whole country, has brought about a healthy attitude on the part of the owner and operator towards maintenance and management of Diesel equipment with the result that any progressive owner of a number of Diesel engines or his operators gives quite as much attention and care to the supervision and maintenance of his power units as the railroad and ship owners have long since learned to accord their large and costly Diesel units.

The principles of maintenance work can be learned only after study and experience with the Diesel engine, however, we will outline the important divisions and suggest those items that require regular maintenance attention, and how these problems are being solved.

Maintenance expense of Diesel engines in oil field service may be reduced and operation made more efficient on installations such as drilling rigs, pumping engines, and powers by using enclosed cooling systems, since the water in most fields contains minerals. Radiator cooling is not very practical for large Diesels except where the water supply is very scarce and this practice has to be resorted to because of the high first cost and reduction in available power to handle the radiators. A simple cooling tower often will suffice for a small engine, a closed system using only soft water will be needed on larger engines, or a complete water-treatment method may have to be employed in large installations.

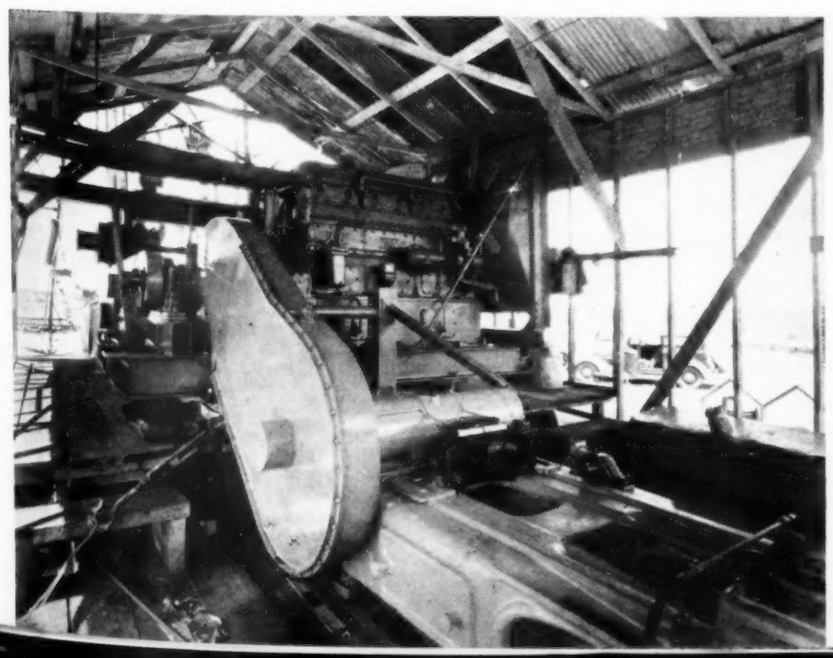
A small item of expense is involved in the matter of automatic devices for cooling water and lubricating oil, and likewise exhaust pyrometers are worth all they cost to warn against overload. These additional devices, long used on other applications, are the best and cheapest insurance against high maintenance cost. No operating organization should handicap itself by the use of inefficient equipment and wasteful methods, and such an organization will supply these necessary auxiliaries for the protection of Diesel equipment.

Continuous attendance of one or two units by the operator is poor practice and adds nothing to the reliability of the engines. Routine duties that require time of the operator can be safely entrusted to automatic controls and safeguards. Such devices are simple, have been thoroughly developed, and require but little care to keep in operation. The attendant is left free for other work and for using his head.

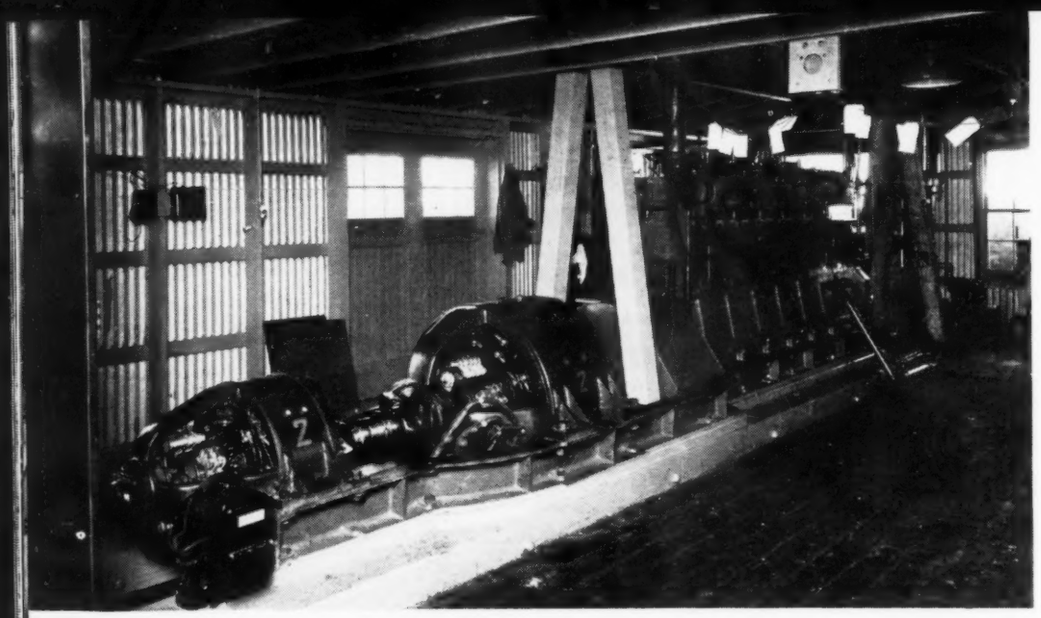
Lubrication on the modern Diesel engine requires very little supervision. Engines usually provided with pressure lubrication have duplicate pumps that reduce the possibility of failure of the lubricating system. In order to guard against breakage in pipes, and many other possible interferences with the free flow of the lubricating oil, alarms are provided to warn the attendant when the pressure is too low or when the temperature of a bearing is too high. Several methods are now in use to shut off automatically the fuel pumps and stop the engine if the lubricating oil pressures at any point in the system become dangerously low. Another advantage of this device is that the engine cannot be started until the oil pressure has been built up through the system. This insures the moving parts of receiving oil at the very start.

By keeping the lubricating oil clean, there is little chance of oil lines clogging. In fact, there is no reason for the lubrication of a Diesel engine not being made as automatic and foolproof as that of the automobile engine. This is now being done on most Diesel engines, particularly the high-speed units.

Fuel supply failures are not so serious, and will result only in a shut



Diesel engines driving mud pumps. Photograph taken in Cowden field, Odessa, Texas



A 200-hp. Diesel engine driving a 125-kw., 250-volt d-c. differentially-compounded generator, and a 15-kw., 250-volt d-c. exciter. Equipment used for rotary drilling by Ward-Leonard control

down of the engine, although such interruptions in service need not be tolerated since a means of prevention is available. Adequate precautions are necessary to maintain clean fuel by the use of a series of filters and strainers all the way from the delivery of the fuel into the main storage tanks to the spray valves on the engine itself. The simplest type of fuel system is usually the overhead day tank in the engine room that is filled once a day or each shift from the main storage tank. If the tank is large enough and is provided with some form of gauge there is no likelihood of the fuel supply running low. Of course an alarm may be used for this, but usually it is not necessary.

It is now good practice to use pyrometers to measure the temperature of the exhaust gases. This is a good method of checking the temperature of the cylinders; a uniform temperature is an index of uniform performance and load. Such a check on the engine's temperature and balance takes but a few minutes, and if the cylinder temperatures are found to agree within reasonable limits the attendant is safe in assuming that each cylinder is doing its proper share of the work. Many difficulties formerly encountered in the operation of multi-cylinder engines could have been avoided by the use of such pyrometers for measuring exhaust temperature.

Considerable care is required in the layout of a cooling water system if the water is unsuitable for the service. The damage that hard water can cause is recognized everywhere and closed cooling systems are employed that continuously re-cool the circulating water, which if not soft is either chemically treated or softened by the use of a water-softening system. Even when cooling direct with water that is not too hard, water can be saved at small expense with the evaporator-type cooling towers. These towers are regular factory made and are commercially marketed. They are constructed of pressed metal in well-designed shapes and in non-corroding material if desired, and are superior to home-made equipment in many respects.

Some installations will justify lubricating oil purification. Formerly the lubricating oil, when it became heavily contaminated with fine carbon particles washed off the cylinder walls, was thought to be used up, and was either thrown away or used for machinery and shafting lubrication in other parts of the equipment after a simple filtering process. It is now the practice to purify the oil by a centrifuge, or by coagulation and settling with the aid of chemical reagents. The chemical process is particularly effective and even restores the oil's original color. Not only does purification save the cost of new oil, but it assures the quality of the oil in the system being held constant. Engines of Diesel type may be very wasteful of oil, unless a reclaiming system is used in connection with the installation. The lubrication system of drilling rig engines should be carefully guarded against contamination. It is very likely that on many of the modern heavy drilling rigs it would be profitable to have a reclaiming system, as much for the assurance of a constant supply of good oil as the savings involved.

It is easy to overdo this matter of auxiliaries, however. Expensive auxiliaries are not always justified and many of the oil field engines operate under conditions of service where a few refinements are justified. Decision on whether to use water-softening equipment, oil-reclaiming devices and systems, centrifuging machines for the fuel and lubricating oil, closed cooling systems, and pyrometers, can be made only after a careful study by a Diesel engineer who knows his business of the application, the operation, and the type and design of engines used. Experience in the field will determine more than any other factor just how much can be spent for such equipment.

The initial cost of such installations will be increased by the engineering study necessary to assure a thoroughly planned and economical installation in advance of more expensive experience lessons, and the cost of the several refinements and auxiliaries that may be required. It has been the writer's experience that the cost of making a correct layout and of installing the proper refinements, auxiliaries, and equipment is fully repaid by the ensuing operating savings; and in addition, the performance of the engines is greatly improved.

Instead of entailing additional maintenance detail and expense, the use of such refinements and safety devices reduce the hazards of operation and also the maintenance expense. The question resolves itself into the simple problem of whether the investment is justified from a long range viewpoint. The whole problem of maintenance and repair is influenced by the presence or absence of those aids and helps toward proper operation. In this connection it should be kept in mind that any engine, Diesel or gas, however well designed and logically suited to the application, will not give satisfactory results and will doubtless show a high maintenance and repair cost if it be cooled by raw water of just any kind available or burn raw fuels of any grade at hand without regard to their suitability. Operation will suffer likewise if the engine is carelessly lubricated, or is forced to breathe in air whatever the location without the benefit of air filters to remove dust contamination. Under these conditions, which after all are the conditions under which most Diesel engines have had to operate in many years past, cylinder wear, bearing wear, wear and depreciation of the intricate and delicate fuel pumping and injection system, will be rapid and costly as compared with the results assured by the proper safeguards, an intelligent maintenance plan, and a thorough knowledge of what maintenance involves.

# Fuel Oils For Diesel Engines

## « Selection and Handling of Fuels has Economic Importance »

THREE important sources of fuels are available for Diesel engines, namely: crude, straight distillate, and cracking still recirculating oils. It is very important to know the relative economy of fuel oils, both as to price and availability and whether the engine in question is designed or adjusted for a particular kind of fuel. As a whole, Diesel engines are not designed to use straight crude; to do so with any degree of success they must be adjusted. Crude oil is almost unknown as a Diesel fuel outside the petroleum industry itself, where it is used in oil pipe line stations. Pipe line engines burn the crude simply because it is available, though a suitable supply of distillate or fuel oil would require separate handling and entail considerable additional expense. Not all crudes are suitable as fuel by any means, although some of the objectional crudes may be made so. East Texas crudes containing a high percentage of wax, for example, obviously are difficult to handle and burn, requiring high pump pressures that sometimes clog the fuel lines between the injection pumps and the spray nozzles. Some of the high-speed engines are sensitive to this kind of fuel and for this reason the use of such fuels should be investigated carefully. Suitable pumps and nozzles usually can be supplied that will handle a highly-viscous crude. It also has been found that many crudes carry a great deal of water in emulsion, rendering combustion imperfect to such an extent that the water must be settled out in large storage tanks before it is used. On the other hand, many crudes contain a very appreciable amount of hydrogen-sulphur compounds, and their use in many types of engines would result in excessive cylinder wear and perhaps cut out the pumps and spray nozzles more rapidly than normal fuels. It is obvious that crude oil cannot be classified as a suitable fuel unless it is given a very good cleaning before use and is properly handled to prevent excessive wear, and unsatisfactory combustion. Of course, pipe line pumping stations using the large engines, particularly those of the air-injection type, are adjusted and equipped to burn this kind of fuel; but this is no good reason for assuming that such fuels may be used in high-speed engines having a sensitive fuel system and in nowise intended to burn crude oil. Some success in burning crude oil in the high-speed engine has been reported, but only after extensive experiment to find out how this may be done with a particular application.

In the early days of the Diesel and up to comparatively few years ago all Diesel fuel was a distillate product produced by refineries where no cracking process was employed to produce gasoline. In those days engines of the Diesel type were sold to run on and burn satisfactorily any "fuel oil that was clean and would flow through a pipe not less than ½ in. in diameter," a specification that hardly could be any broader. Such straight-run fuels, possessing highly desirable characteristics as fuel for Diesel engines, are more difficult to obtain since the introduction of the "cracking still," and, therefore, it is important to know whether an engine will burn cracking still products. This accounts for so much interest being shown in the question of fuels and why a very considerable amount of research and experiment is being carried out to determine and define fuel specifications for Diesel engines. Fortunately for the time being a great deal of fuel coming from the Southwest and Middlewest from local refineries is straight-run distillate that can be used very satisfactorily when properly handled. On the other hand, taking the country as a whole, the greater amount of available Diesel fuel oils are cracking still products. Such fuels may have a gravity and other characteristics equal to that of the straight-run distillates, and such fuels may carry a greater amount of carbon, a result of the cracking process.

Cracking still products are found to be quite suitable for slow-speed and even the medium-speed engines and Semi-Diesel engines. In the case of the high-speed engine, however, the ignition lag may be so great as to render the use of this kind of fuel very unsatisfactory. A good fuel is made by blending a recirculating oil and a cracking still residue. Considerable research is being done at the present time to find the best means of blending to obtain most satisfactory combustion. Some tests have been made that indicate that blended fuels with a carbon content as high as ten percent may be burned in slow-speed engines; but unsatisfactory results in the medium-speed engines are reported by experimenters when this fuel contains as much as five percent. Carbon content is no longer regarded as the most important determining factor, for much of the carbon content of the blended fuel may be removed by suitable filtration and treatment. This, however, involves expense not acceptable in oilfield operations.

For a good many years the fuel oil known as Bunker C, the cheapest fuel for Diesel engines on the market, has been used successfully in the large slow-speed air-injection and solid-injection engines. Such fuel contains a considerable amount of dirt and must be centrifuged before use. The centrifuge has not been able to remove entirely all the objectional foreign matter and carbon, and its use is almost always accompanied by sticking rings and increased cylinder wear. The high maintenance cost has been accepted, however, as offset by the very low price for which Bunker C fuel usually can be obtained. It should be remembered that there may be a variance of as much as 50 percent in liner wear, and such an increase in wear must be charged against the fuel that causes it.

In the petroleum industry, however, all the various kinds of fuel oils are available and it follows that a fuel most suitable to the particular engine should be used unless the cost is excessive. The average installation does not demand a fuel that is so cheap that the maintenance cost is increased. Where suitable crude is available at low cost, and the engines can handle such fuels satisfactorily, the transportation of a refined fuel does not seem justified; however, where straight run distillates are available at a price not more than 50 percent above crude prices, the use of such straight-run distillates always is advisable. The equipment and consequent higher maintenance cost that the use of crude entails more than offsets the increased cost of distillates, particularly for drilling operations, for miscellaneous uses,

and for high-speed engines employed in pipe line pumping stations.

Considerable investigation is underway looking toward finding a suitable standard for measuring fuel specification for various types of Diesel engines. Possibly no other product presents such wide variations in specification as Diesel fuels. With the development and application of higher speeds have come very close and very exacting fuel-oil specifications that have been difficult to meet by the oil companies supplying the fuel oils. As an example, oil companies have been asked for Diesel fuel containing less than one-half of one percent sulphur content for high-speed engines. It is found to be very costly to reduce the sulphur content to this amount and on the other hand, such a low sulphur content is not necessary if the engine is properly designed and adjusted.

Many engine builders are now constructing units intended to burn a fuel meeting certain general standards so that obtaining fuels to give satisfactory results will be less difficult to handle and result in lower average prices for those fuels available. Much progress may be expected in the field of Diesel fuels within the next year or so. The increasing application and use of the Diesel engine doubtless will result in a fuel market situation more convenient to the user and better for the manufacturer.

The important characteristics of a fuel oil are ignitibility, combustion knock, and ignition lag. The technical terms involved in a Diesel fuel specification, therefore, seem worthy of study, if proper understanding is to be had of this most important question.

The use of fuel oils that meet certain specifications is desirable regardless of the type of engine. The purpose of specifications is to classify fuels into grades on the basis of viscosity and to indicate the desirable properties of the various grades. To insure reasonable cleanliness there is included in these specifications certain limitations on the water, residue, and coke contents.

What is the significance of the requirements in the specifications?

Viscosity is very important as indicating the results to be expected in burning the fuel. When the viscosity of a fuel oil is too high it will impede the flow of the fuel to the pumps and may interfere with the delivery of the fuel into the engine, indicated by poor atomization and excessive penetration; however, since the viscosity is related closely to temperature, it is easy enough by providing for temperature control to adjust the fuel viscosity to the requirements of a given injection system and so render the engine less dependent on the viscosity-grade of its fuel. This is accomplished in several ways, and is more important than is generally thought.

Much attention is given to the subject of ignition quality. A few years ago the prevailing opinion was that the upper limit to the speed of rotation would be controlled by the lack of sufficient time for the combustion of Diesel fuels in high-speed engines. Though engines of the Diesel type have been operated at a speed as high as 4000 r.p.m., as yet no such limit has been found. Instead of the time involved to burn fuels, it has been found that another factor in no way related to speed influences the performance of an engine, namely ignition delay or time lag. Between the start of injection of the fuel into the combustion chamber and the time at which the fuel begins to burn there is a delay period, which for a given engine, fuel, and injection timing is approximately constant when measured in degrees of crank angle. When the ignition delay is too long, this allows a large amount of fuel to be injected before burning starts, and, as a result, the rate of pressure rise is too rapid immediately following combustion. This produces a "Diesel knock" and seriously interferes with the smooth running of the engine. When burning starts too soon after the beginning of injection there is another difficulty that will arise, even though the motor operates smoothly. This will be discussed later.

Any condition that tends to retard combustion lengthens the delay period and produces knock in a Diesel engine. Reduction of the intake air will increase the delay and cause knock. On the other hand, supercharging tends to reduce the delay period and promotes smooth running of the engine. It is evident then that the method of mixing the fuel and air and the physical conditions of these elements during the mixing process have an important influence on the initiation of combustion; hence it follows that the engine design has a great influence on ignition lag.

Ignition delay depends upon the chemical nature of the oil. It is said that the more paraffinous types of fuel ignite most readily, while the aromatic fuels have longer ignition lag. Thus the requirements of the Diesel engine in regard to the chemical nature of the fuel is the reverse of that of the spark ignition engine in which a high resistance to self-ignition is desired for the purpose of avoiding pinging or knock. This important difference between the two types of engines should always be kept clearly in mind.

In the spark-ignition engine, with a homogeneous charge of fuel, the power output is definitely limited by the knock rating of the gasoline. After the onset of a certain intensity of detonation no further increase in output is possible under the usual conditions of working, and attempts to raise the output by increasing the compression ratio or degree of supercharge only intensify the knock in the gasoline engine. In the Diesel engine ignition delay is more pronounced by knocks at low loads than at high loads. When the engine load and temperature are increased, the delay period is shortened and the knock is reduced or eliminated, the engine running smoother the greater the load. Thus it is that the power output of a Diesel engine is not limited by the ignition quality of its fuel in the way in which the output of a spark-ignited engine is restricted by the anti-knock value of the gasoline that it burns.

A too short ignition delay, undesirable according to many experiments made during researches by Boerlage and Broeze, the maximum power output of a high-speed Diesel engine is lower on fuels of high-ignition than on fuels of medium-ignition quality. The reason for this is the fact that ignition takes place too rapidly on the high-ignition fuel to allow adequate mixing of the fuel and air before combustion. There are, of course, many technical explanations too numerous to go into here. Quite apart from the cause of this condition, however, the point is an illustration of the general statement that the power output of a high-speed engine is not dependent upon the use of a fuel of high-ignition quality, and that fact is worth remembering when there is a temptation to use kerosene or light distillate in engines.

Since very few engines are called upon for maximum power development, and since smoothness of running is desirable instead, the operator is not going to run into either difficulty unless he uses fuel obviously unfitted for his engine. The first cost of oil engines being high and getting the power out of them is the return on the investment, roughness of running is objectionable, hence the use of high-ignition quality fuel may become quite common, particularly since these engines are required to start without trouble in cold weather and are easier to start on such fuels. There may be the temptation, however, to use fuels of too high viscosity by operators who find by experience that these fuels get the engine under way sooner. The temptation to go "too far" in this direction must be avoided. The operator should

know more about the effect of fuels on his engine and therefore be able to obtain better performance.

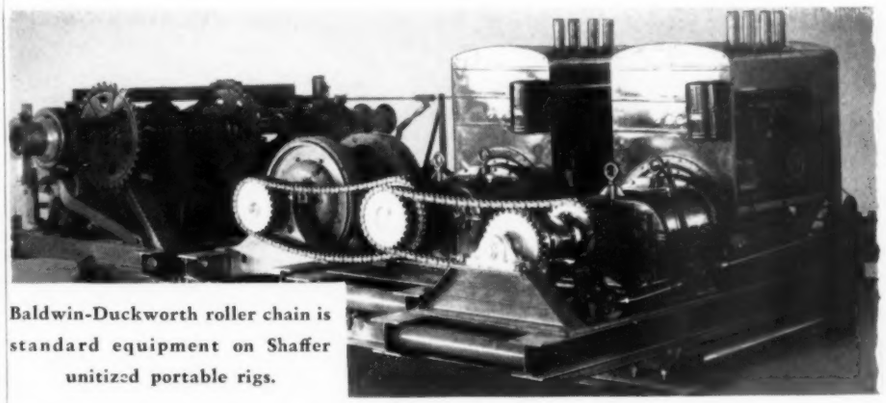
Fuel of high volatility appears to result in poor penetration and distribution in the combustion chamber, due to its rapid evaporation after injection, and it may form a certain amount of homogenous air-fuel mixture that will result in pre-ignition. Increasing viscosity means diminishing volatility, consequently the effect of high viscosity in reducing the degree of atomization and increasing the pentration also may go hand in hand with reduced evaporation of the fuel from the spray. As the fuel becomes "heavier," therefore, it tends to pass through the combustion space without atomization and hence without increased burning speed. The addition of large amounts of heavy oil to light Diesel fuels is prevented by the maximum viscosity requirements of the specifications. Due to objection to the presence of heavy fuel in light Diesel oil usually there is imposed by the specifications a limit to the distillation properties of the fuel, such as maximum percentage distilling to, say, 325 deg. cent. to 350 deg. centigrade. The limitation does not seem warranted, however, except in the case of very light fuels for certain high-speed engines. The general performance of fuels is well indicated by other properties.

An important limitation in fuel specifications is the sulphur content. The sulphur burns in an engine to sulphur oxides, which are acid-forming in the presence of water and therefore objectionable. This subject is today not well understood, and it is expected that more information will become available in a short time; however, it is common practice now to fix the limit of sulphur content to one or two percent for light fuels. It is expected, however, that the need for such limits will tend to be less apparent with the increasing use of corrosion-resisting metals.

With the object of insuring the fluidity of the fuel in the supply tanks at the low temperatures, maximum pour point frequently is important, particularly where provision has not been made for heating the fuel in the tank. Low-viscosity fuels also do not flow readily below their pour-point. High-viscosity fuels, on the other hand, may be so viscous at a temperature higher than their pour-point as to require very high pressures to produce an appreciable flow at a rapid rate. It is obvious that temperature control of the fuel system for the purpose of maintaining the viscosity of the fuel within workable limits is important. This is a very practical provision to make in connection with the layout of the installation if the plant is to be operated in cold weather.

Other minor requirements in fuel specifications merit some thought, such as ash and water content, fuel value, etc. The less water in the fuel the better; however, a properly-designed fuel system prevents trouble from the value of water usually present in fuel oils. The heat value of a fuel likewise is important from a dollar and cents standpoint; fuels of the same specifications vary within rather narrow limits as to the B.t.u. content and this is important only from a laboratory and testing standpoint.

Good fuel oil filters are important in obtaining the best results. The small injection pumps of high-speed engines, capable of metering and injection of small quantities of fuel oil at high pressures, are necessarily affected by the presence of any dirt, grit, and sand, and these particles of foreign matter should be removed from the fuel by filtering.

Baldwin-Duckworth roller chain is standard equipment on Shaffer unitized portable rigs.

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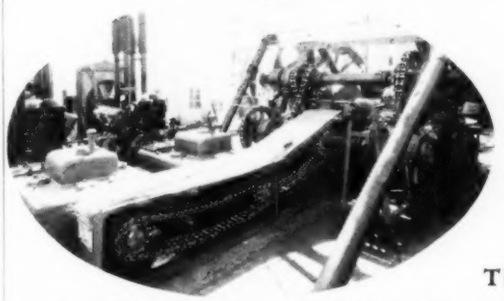
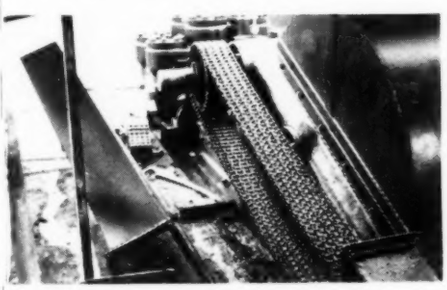


Here Baldwin-Duckworth multiple width roller chain hooks Diesels to jack shafts.



The slush pump drive using Baldwin-Duckworth multiple roller chain.

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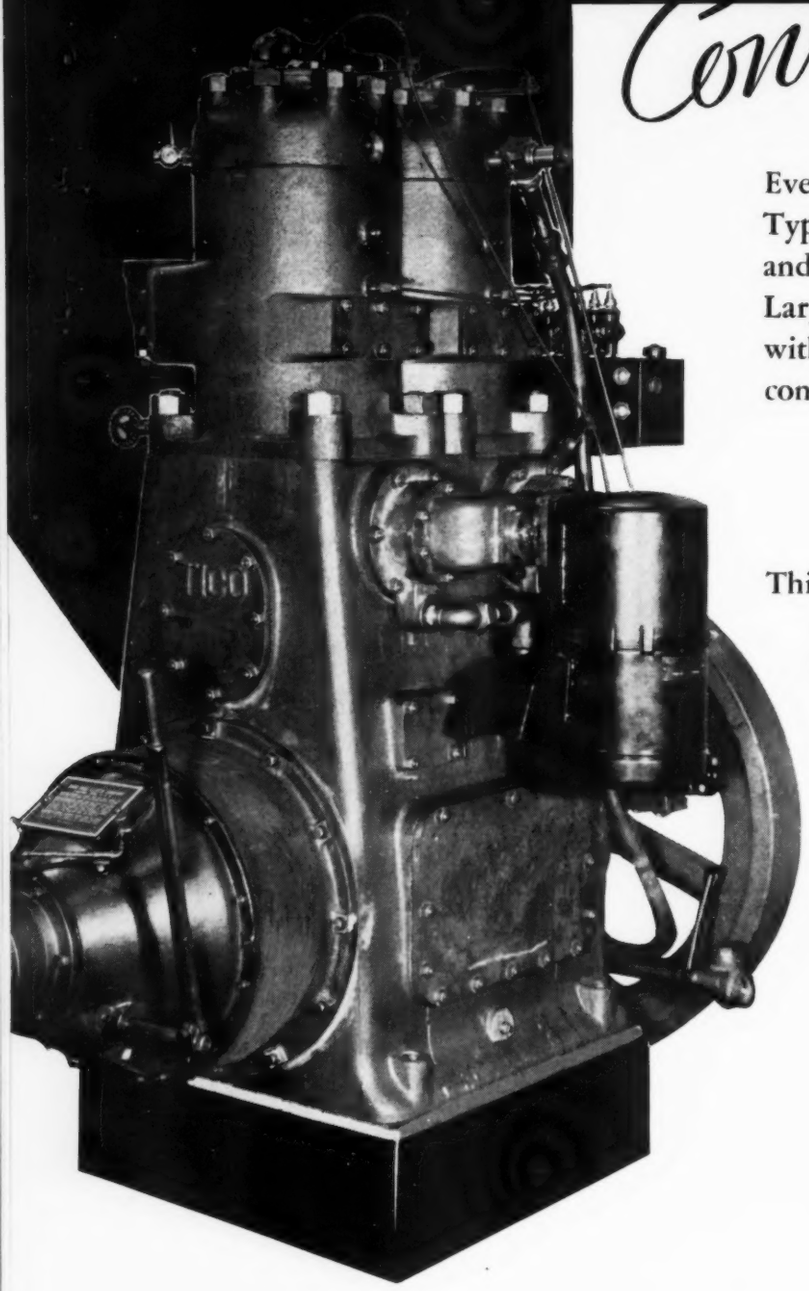


## Convertible to Gas

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Every conceivable test has been given the new TICO Type V-10 Twin Vertical Two-Cycle Diesel engine and we now pronounce it ready for Oil Industry use. Large and powerful, weighing 5600 lb., this engine, with a 10-in. stroke and 7½-in. cylinder, is rated conservatively as follows:

**44 HP at 400 RMP**
**48 HP at 425 RPM**
**51 HP at 450 RPM**

This same engine, convertible to gas—with a 10-in. stroke and 9-in. cylinder—will develop the following horsepower:

**67 HP at 400 RPM**
**71 HP at 425 RPM**
**76 HP at 450 RPM**

## MAJOR SPECIFICATIONS

- Timken roller bearing crankshaft, auxiliary drive and water pump drive.
- Crosshead equipped with two bronze shoes and a replaceable full-size wrist pin bushing of bronze.
- Complete lubrication is effected by splash to all main parts—flood to auxiliary drive and force feed to cylinders and governor.
- Diesel is equipped with Bosch injection—gas engine with Scintilla magneto.
- Pickering governors.
- Torrington lubricators.
- Nickel cast iron cylinders.
- Alloy die-forged crankshaft.

This engine has been under design and test for 30 months and is constructed to stand heavy shocks incidental upon high compression. Price consideration was secondary, as this engine was built for hard service 24 hours a day and a lifetime of service.

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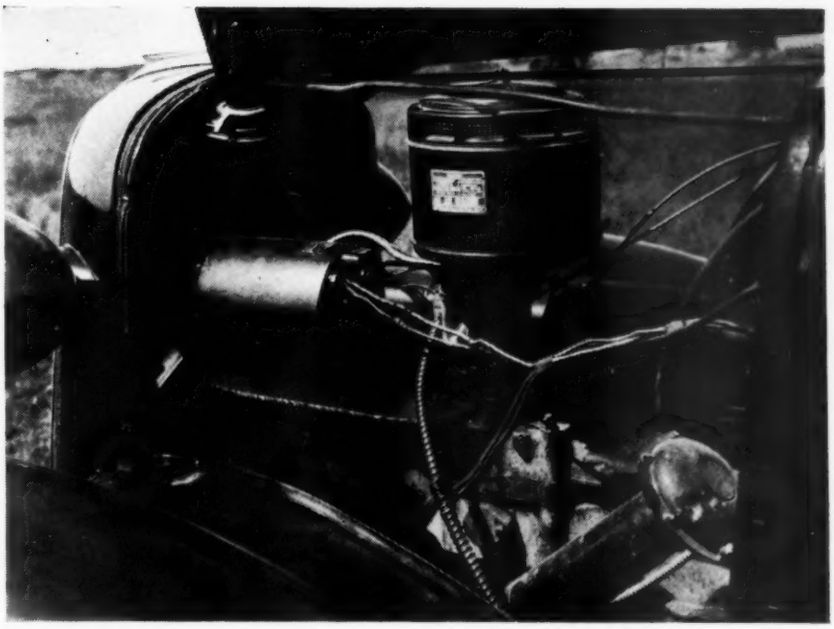

Fig. 1. An a-c. generator installed on a sedan-delivery type car

By
DAVE HARRELL
Corrosion Engineer,
Houston Pipe Line Co.

●

Number of Holidays in Enamel Pipe Line Coating Determines to a Considerable Extent the Cost of Cathodic Protection—Detector That Has Proved Efficient Has Been Devised by One Company

# Detection of Holidays in Pitch Enamel Coatings » » » »

WERE it not for the existence of holidays in coating jobs where hot pitch enamels are applied to oil and gas pipe lines cathodic protection units would not draw enough current to be effective on such lines. The very fact that most companies operating in the Gulf Coast area have installed numerous units supplying adequate electrical protection to lines where high resistance pitch enamels have been meticulously applied proves the existence of such holidays on jobs that were considered free from them.

The amount of current necessary to provide protection certainly is directly proportional to the number of holidays left in the coating job. It is desirable therefore to have as few such points of exposure of the pipe as possible in order to reduce the unit cost of cathodic protection. With this purpose in mind the Houston Pipe Line Company developed a detector that we believe is as efficient as possible up to the present time; however, numerous small wind-generating plants installed on such coated lines in the past two years are proof that the jobs were not free from holidays; nevertheless, we attribute the marked degree of success obtained by the use of this unit to the effective finding and repairing of holidays while the coating job was in progress.

Our holiday detector originally was developed for use on replacement jobs generally not more than a mile in length and on which the factor of speed of operation was not so important. It consists of a small wooden box containing four No. 6 dry cells and two spark coils. This box generates the high voltage necessary for the jump spark and is extremely light and portable. Two detector rings are used, one for each spark coil. These rings are on a split frame that fastens around the pipe and is provided with four casters supporting the weight of the frame and keeping the frayed copper screening, used to cover the surface, at an even distance and even tension all around the pipe. This makes it unnecessary to use expensive spring-tension steel wire as a detector covering. These casters also serve another purpose since they are slightly

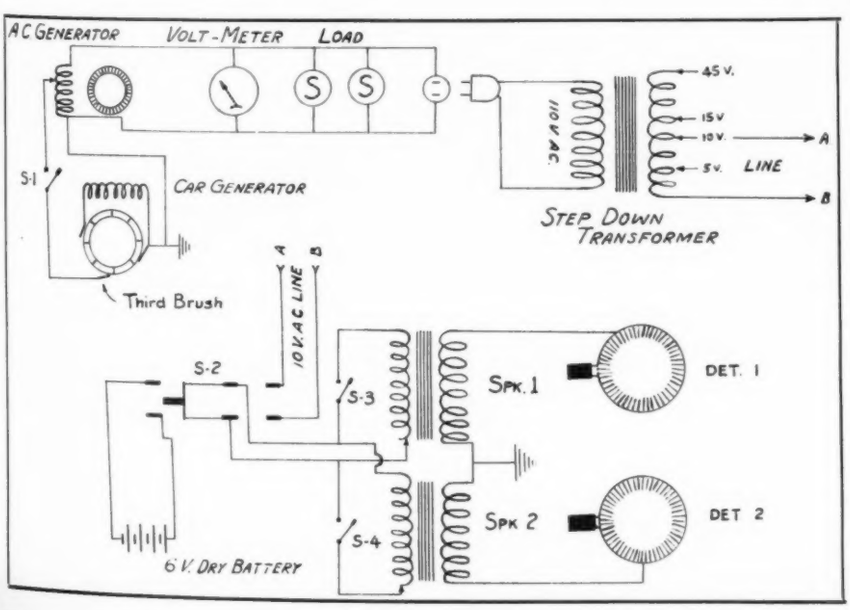


Diagram of a-c. generator and holiday detector

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. . . drillers everywhere are finding that TRU-LAY Preformed Rotary Lines make the job easier, save time, and give all around better results.

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TRU-LAY Preformed Rotary Lines not only help cut down the unproductive round-trip time, but they last so much longer that they frequently save their own cost in reduced time-out for replacement.

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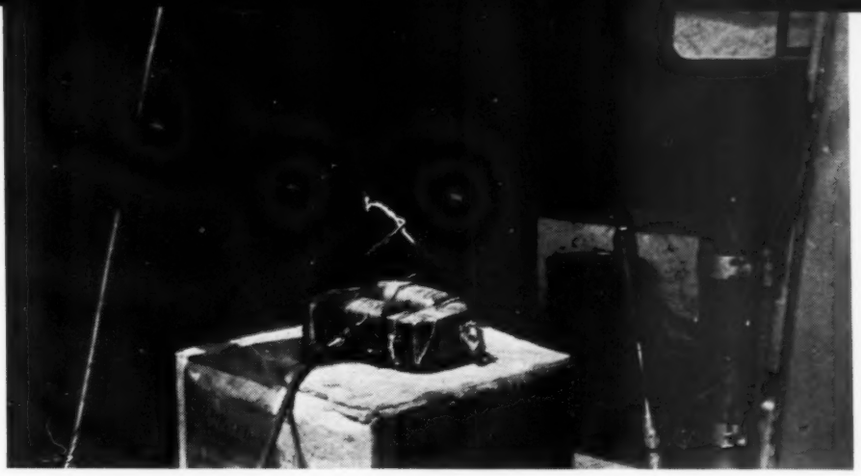

Fig. 2 (top). Step-down transformer and an a-c. voltmeter mounted in the rear of a car with the cable leading off

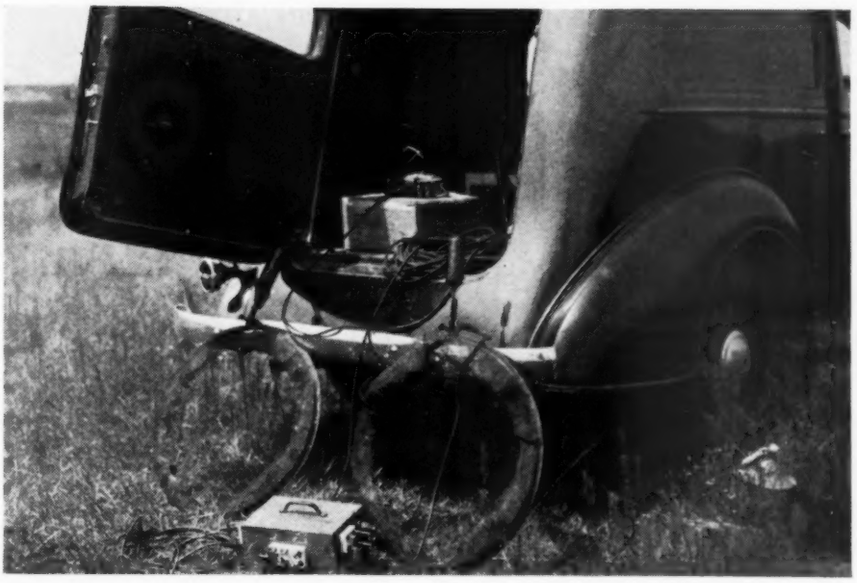

Fig. 3 (below). Showing the entire equipment assembled

offset so that the ring can be pushed along down the pipe only by imparting an up-and-down motion to the handle. This keeps the operator from getting in too big a rush and running the detector too fast.

Recently it became necessary to adapt this device to long line operation and several changes were required. The use of small dry batteries make the detector extremely portable, but it means also that they must be renewed every 3000 ft. or so while in continuous operation. Storage batteries are an ideal source of power for such detectors and have been used in them for a long time, but they are heavy and also become exhausted and have to be recharged. They are so bulky that they must be pulled along in a wagon of some kind or carried in a car, and neither system is very satisfactory. If a long flexible cable is used its resistance is generally so high that the voltage drop from the 6-volt battery in a car or truck is too high for satisfactory operation of the detector.

Fig. 1 shows a 175-watt, 110-volt a-c. generator installed on a sedan-delivery type car. The generator is mounted on a steel plate secured to the engine block by the original engine bolts and its pulley driven by an extra long fan belt.

By referring to the diagram of connections it will be seen that the a-c. generator is of the stationary field type with a revolving magnetic segment armature. It gets its excitation from the third brush current of the d-c. car generator, so draws no current from the car storage battery when it is in operation. A small snap switch mounted on the dash board of the car and designated as "S1" on the accompanying diagram opens and closes the third brush circuit, and when it is open the generator is not in operation, even though the car may be running at high speed. When this switch is closed the field of the generator is excited, and it is only necessary to idle the motor at about 600 r.p.m. to obtain full rated output from the machine.

It also will be noted by observing the diagram that a fixed load is shunted across the generator. This is because the holiday detector only draws about 50 watts, and the machine must be loaded in order to obtain adequate voltage regulation under varying load. Two 60-watt lamps are placed in parallel across the output and mounted in the rear of the car as shown in Fig. 2, so that the operator may sit at the wheel and adjust the voltage to the load by varying the idling speed of the car.

The step-down transformer in the diagram of connections is shown on top of the battery box in Fig. 2. This transformer has a maximum output of 200 watts and a tapped secondary winding that can supply anything from 2½ volts to 45 volts. This transformer is now feeding ten volts through a 100-ft. piece of superservice cable, and very successful operation has resulted; however, a wire 500 ft. long could be used just as easily. If it is impossible to get the car within 100 ft. of the line, the plug on the wire is pulled and the double-pole double-throw switch on the box thrown to the left position, so that the detector can continue under its own power from the batteries in the box. When the car again can be brought up alongside the line the switch is thrown the opposite direction and the plug on the 100-ft. cable inserted in the socket and operation from the a-c. generator renewed without stopping the search

Fig. 4. The detector in actual operation on a replacement job

for pin holes in the coating. There are very few, if any, locations along a pipe line job where the car will have to be abandoned for more than 2000 or 3000 feet.

Fig. 2. shows the step-down transformer and the a-c. voltmeter mounted in the rear of the car with the cable leading off.

Fig. 3 shows the entire equipment assembled. The double-pole double-throw switch for changing sources of power is shown on the front of the box and the individual coil switches designated as "S3" and "S4" on the diagram are seen at the ends of the box. The standoff insulator on the end of the box is the high-voltage outlet to the pickup rings, while the common ground connection to the two coils is obtained by the use of a sharp spike on the bottom of the box that enters the earth whenever the box is placed on the ground.

Fig. 4 shows the detector in actual operation on a replacement job where 18-in. pipe is being coated with pitch enamel.

This small a-c. generator has a variety of other uses, such as providing flood lights for night work, heating electric soldering irons, and running small electric motors. It is only necessary to keep the bearings well oiled, as there are no collector rings or brushes to get out of adjustment.

# Diesel Engine Hook-ups On Texas Rotary Rigs

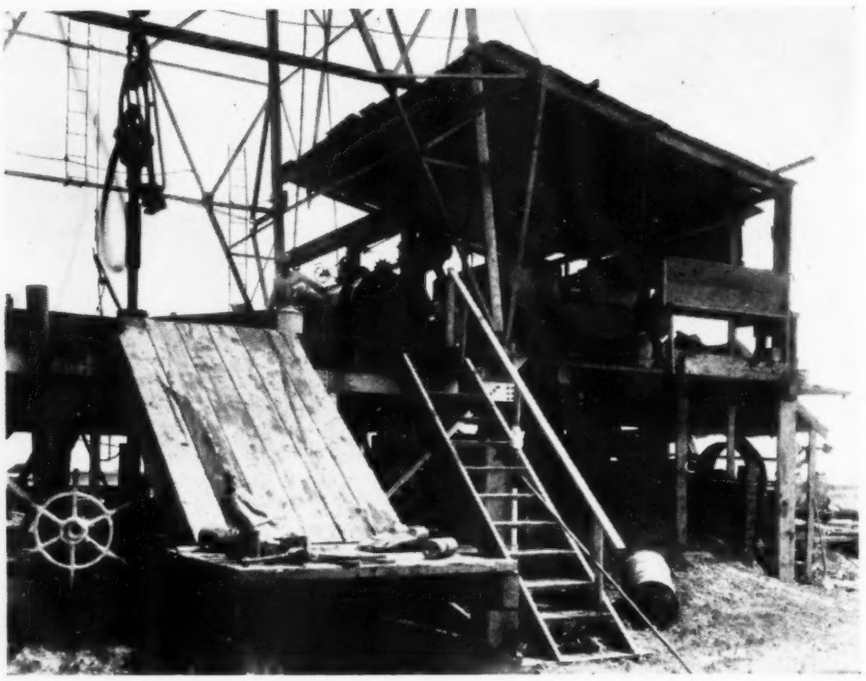

Fig. 1. Ingenious hook-up of Southwest Drilling Company near Corpus Christi, Texas

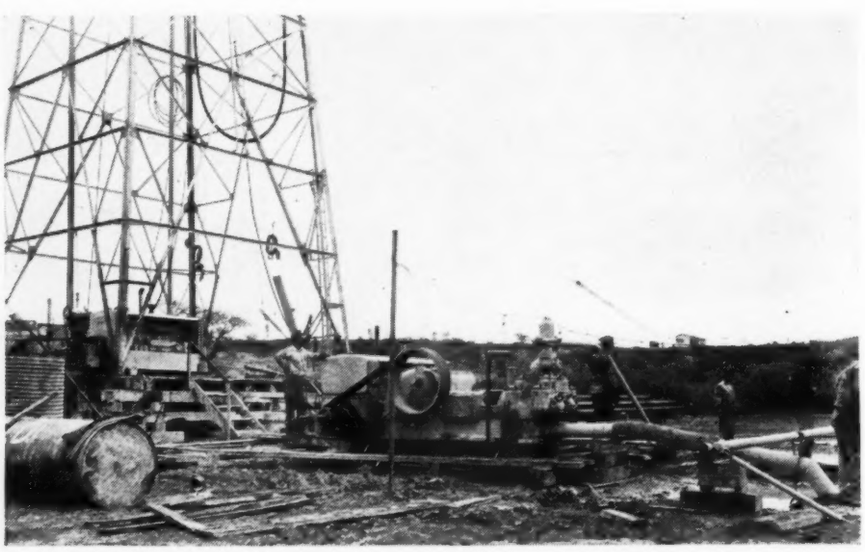

Fig. 2. Drilling operation near Sullivan, Texas

TWIN "Caterpillar" Diesel engines have been hooked up in an ingenious manner by the Southwest Drilling Company, enabling each engine to work on a separate job, or when the occasion arises a clutch can be engaged that throws the full power of both engines to one task. Controls have been extended so that the engines may be operated from the drillers' stand.

The rig shown in an accompanying illustration (Fig. 1) is a rotary operating near Corpus Christi, Texas. Records show that this outfit drills a 4000-4500-ft. well on 1000 to 1200 gal. of Diesel fuel.

Fig. 2 shows an oil drilling operation near Sullivan, Texas, that is equipped with "Caterpillar" Diesel engines. One power unit is utilized to drive a Sheldon-Burdon drawworks on a rotary rig, another unit operates a Gardner-Denver 6¾-in. by 14-in. mud pump, and still another is used for driving the generator to provide lights.

The well, which has reached a depth of 2750 ft., is owned by Don Danvers of Mission, Texas.

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Elliott Core drills are virtually made to order for the specific requirements of operating oil companies. They had to be in order to maintain their leadership over this long period of time. The current Model A Elliott Combination Rotary Core Drill is the ultimate development of all the knowledge and experience gained since Elliott blazed the trail in oil well coring practice more than a decade ago.

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4731 E. 52nd Drive, Los Angeles, California, U.S.A.
Export Office: 420 Lexington Ave., New York City

# ELLIOTT *Combination*

## ROTARY CORE DRILLS

# Inexpensive Alarm System for Pipe Line Stations

By
JOS. L. INGRAM

AN effective and efficient alarm system may be constructed in any shop or engine room of a pipe line station at a cost of only a few cents. One or more of the bells shown in the accompanying illustration (D), and used as the alarm, may be placed in the office, shop, or anywhere convenient, and where they can be heard in case of alarm. The fuse, or contact point, may be situated in any out-of-the-way place where fire or explosion could be expected. They can be hung in wells where gas is likely to accumulate, in rag bins, closets, oil houses, in front of boilers in case of flare-back, in corners, and places seldom visited. By making a slight change in the fuse end of the clothes-pin, they may be used as a high-water alarm and hung in the floor sump, around lubricating oil tanks in the ground, or in water tanks to prevent their overflowing by giving a level alarm.

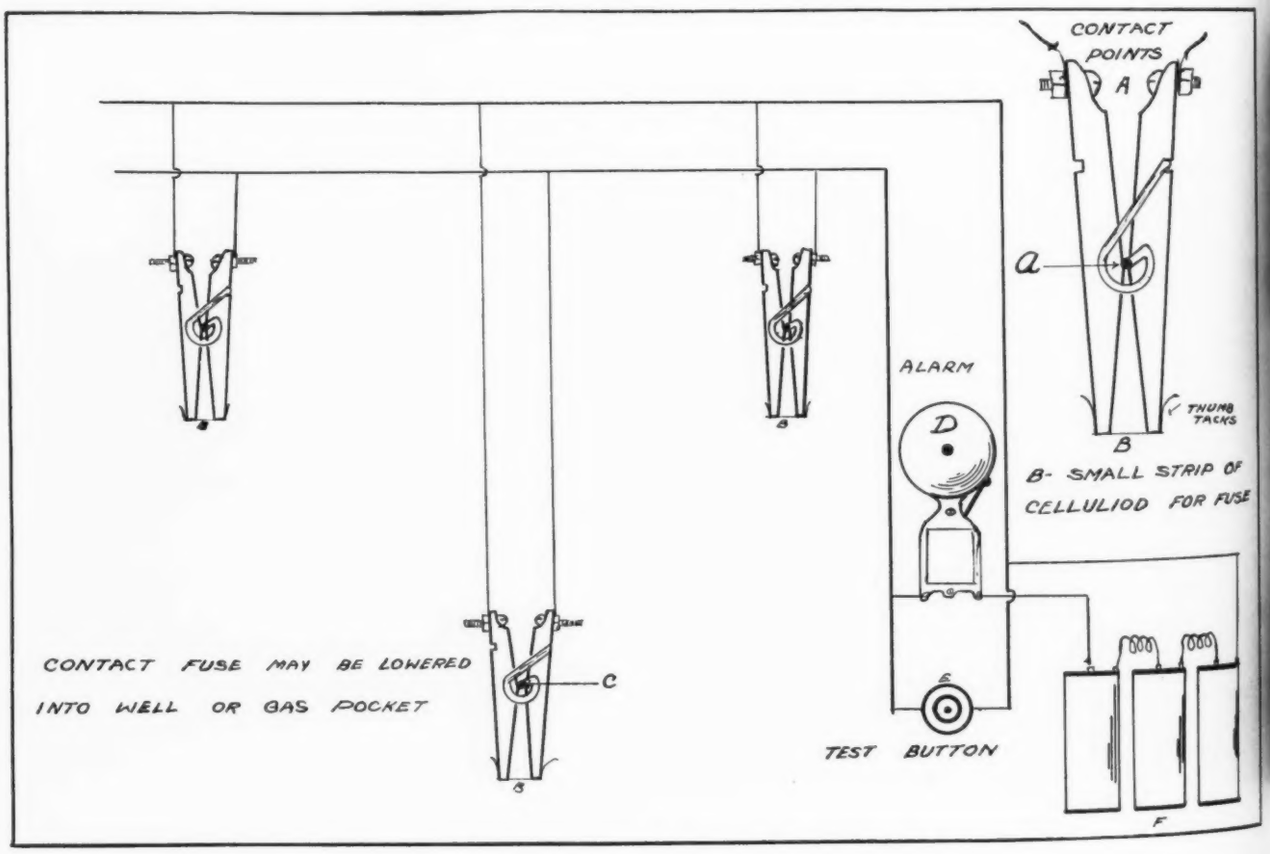
Take the clothes-pin as shown in (a), and whittle the ends to suit the contact (A). Two small brass bolts are used to make the contact and hold the wire. If it is desired to fit the alarm fuse to the wall, or other fixed position, it may be accomplished by using a small nail through the pin near the spring center. Care must be taken that it does not bind and prevent the pin from closing. In using a contact section for fire warning, a small strip of celluloid is cut from an old eye shade and fastened around the end of the pin either with thumb tacks, or by slotting, in such a manner as to hold the contact ends apart. In case of fire the celluloid will immediately ignite and let the spring on the clothes-pin snap the contact shut.

It is a good idea to place the batteries close to one of the bells that serves as an alarm, and install a push button for testing both the batteries and the ringing of the bells.

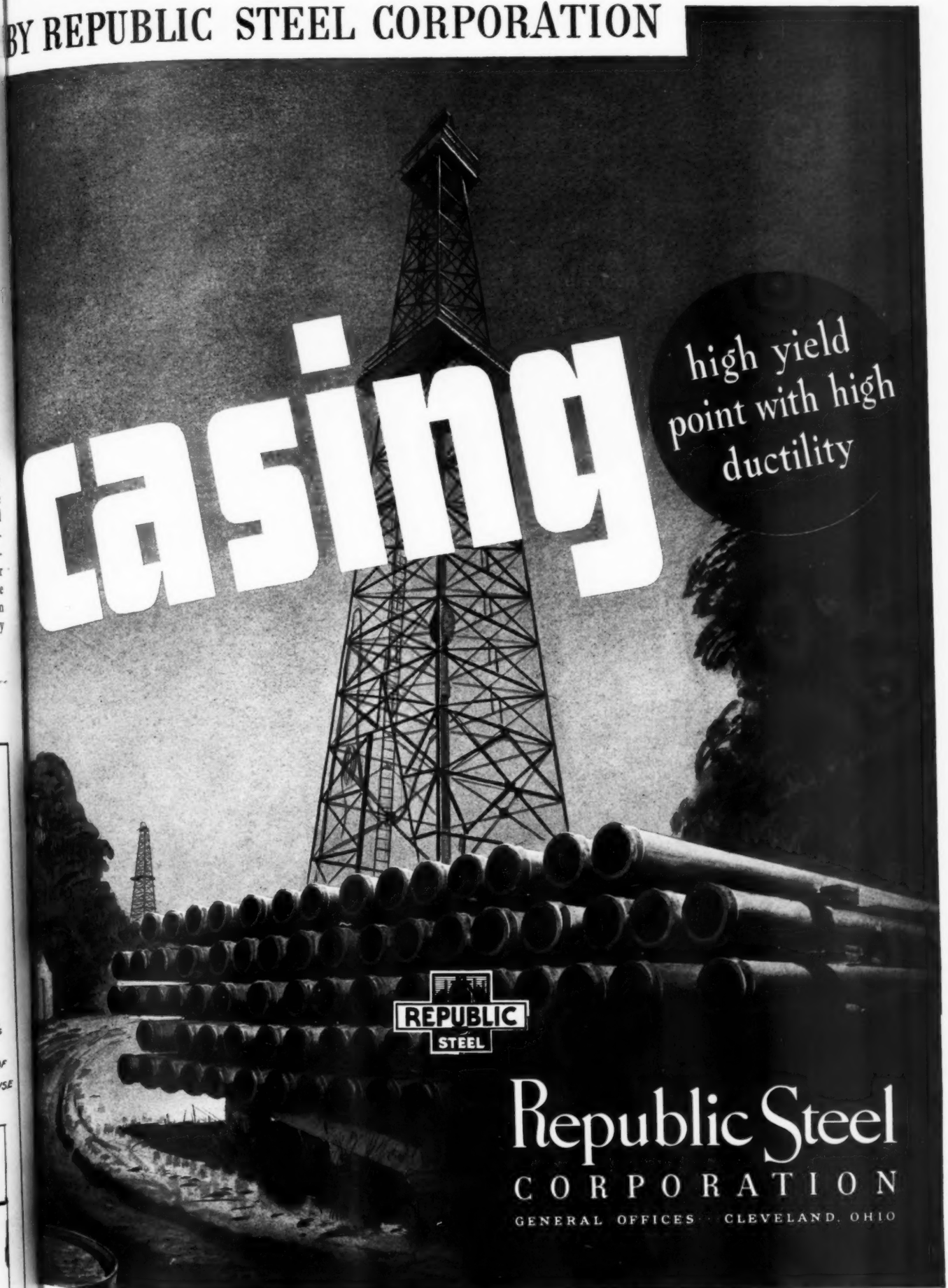
Should a high-water alarm be desired, a piece of absorbent paper is used to hold the contacts open instead of the celluloid. As soon as the water comes in contact with the paper it weakens, letting the spring in the clothes-pin pull it in two. Steam will do the same thing.

The apparatus can be turned into a burglar alarm by attaching the contact pins to doors, windows, or other openings in such a manner that the points close when they are tampered with. By placing in drawers, tool cabinets, under certain tools, under automobile wheels, and in many other places they will tell when meddlers are around. The efficiency of the system will depend largely upon the ingenuity of the man doing the work.

Diagram showing details of alarm system



BY REPUBLIC STEEL CORPORATION




*When writing* REPUBLIC STEEL CORPORATION *for further information, please address Department PT.*

# Production of Drying Oils From Cracked Gasoline

By GEO. M. WOODS

DURING a recent investigation to ascertain possible new degumming methods for cracked gasoline, the possibility of oxidizing the unstable products in gasoline by means of air (oxygen) pressure and heat, and their subsequent removal by distilling the gasoline from the gum so formed, it was observed that these oxidized compounds were similar to linseed oil. Due to the similarity between the oxidized compounds and drying oils, the possibility of producing a satisfactory drying oil from cracked gasoline was investigated in the laboratory. The stock chosen for the purpose was a raw naphtha distillate from a Mid-Continent vapor-phase cracked gas-oil operation. The exact conditions under which this sample was produced is not known. Inspection data on the raw vapor-phase cracked naphtha were:

| | | | |
|---|---|---|---|
| Gravity | - | 51.4 | deg. A.P.I. |
| I.B.P. | - | 101 | deg. fahr. |
| F.B.P. | - | 436 | deg. fahr. |
| 5% | - | 153 | deg. fahr. |
| 10% | - | 173 | deg. fahr. |
| 20% | - | 207 | deg. fahr. |
| 30% | - | 236 | deg. fahr. |
| 40% | - | 260 | deg. fahr. |
| 50% | - | 282 | deg. fahr. |
| 60% | - | 305 | deg. fahr. |
| 70% | - | 327 | deg. fahr. |
| 80% | - | 350 | deg. fahr. |
| 90% | - | 378 | deg. fahr. |
| 95% | - | 403 | deg. fahr. |

Portions of the above-cracked naphtha were oxidized for six hours in a 5-liter glass flask placed in an iron bomb attached directly to a compressed air line carrying a pressure of 100 lb. per sq. in., the whole apparatus being immersed in a steam-heated hot water bath. A diagram of this apparatus is shown in Fig. 1. Following oxidation, the sample was cooled, removed from the bomb, and rerun under vacuum to six percent bottoms. The overhead gasoline was similar to the original stock in boiling range, and required further treatment for gasoline production. These six percent bottoms were found to resemble raw linseed oil to a remarkable degree. The drying oil from cracked gasoline, like linseed oil, absorbs oxygen from the air while drying when exposed in thin films. Inspection data on the drying oil from cracked gasoline, compared with similar data on a sample of commercial linseed oil, are given in Table I.

**TABLE I**

**Properties of Drying Oil From Cracked Gasoline Compared With Linseed Oil**

| | Commercial linseed oil | Drying oil from cracked gasoline |
|---|---|---|
| Gravity, deg. A.P.I. | 19.8 | 21.4 |
| Saponification No. | 190 | 188 |
| Iodine No. | 186 | 180 |
| Color, Tag.-Rob. | 18 | 9 |

The drying oil from the cracked gasoline has been used as a thinner in both wood and metal paints, and compared with results obtained when linseed oil was used. The synthetic drying oil compared favorably with the linseed oil in these tests. However, after 12 months' exposure the panels painted with the paint thinned with the synthetic drying oil is beginning to show evidence of cracking. It is believed, however, that a satisfactory synthetic drying oil can be produced from vapor-phase cracked naphtha by careful control of the above-described process.

The cost of preparing synthetic drying oil from vapor-phase cracked naphtha, based on a six percent yield, probably would be very small. The processing cost would consist of the oxidation cost and rerunning cost, and this should not exceed ten cents per barrel. Assuming ten cents per barrel

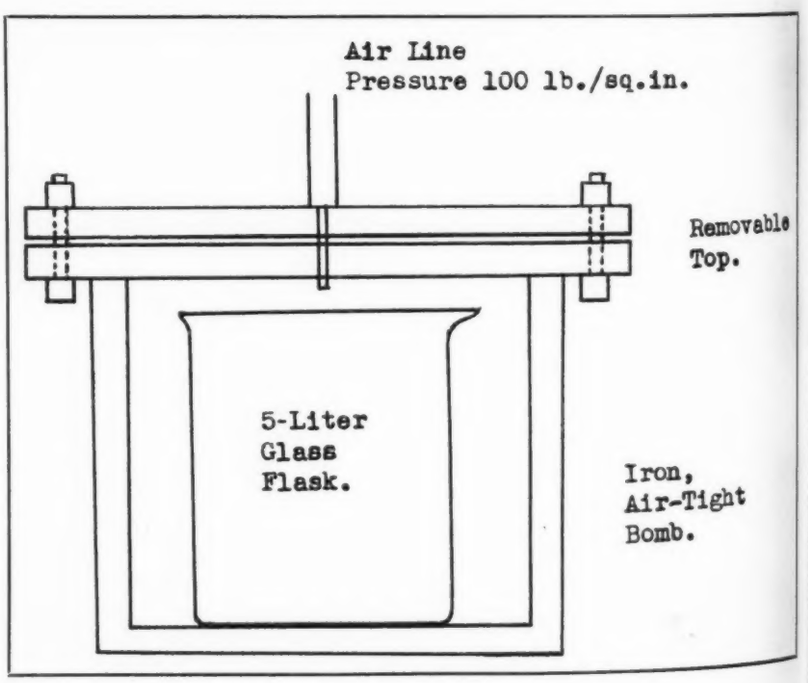



Fig. 1. Diagram of oxidizing apparatus used

Far beyond anything heretofore attempted we now offer to the driller a Rotary Line that really *stands out* in point of service.

Try this new line on your next replacement and get the thrill of an unusual quality line.

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**Williamsport, Pennsylvania** **122 South Michigan Avenue, Chicago, Illinois**

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General Machine and Tool Company, Distributors in Kansas.
American Pipe and Supply Company, Distributors in the Rocky Mountain Territory.

**WILLIAMSPORT WIRE ROPE CO.**

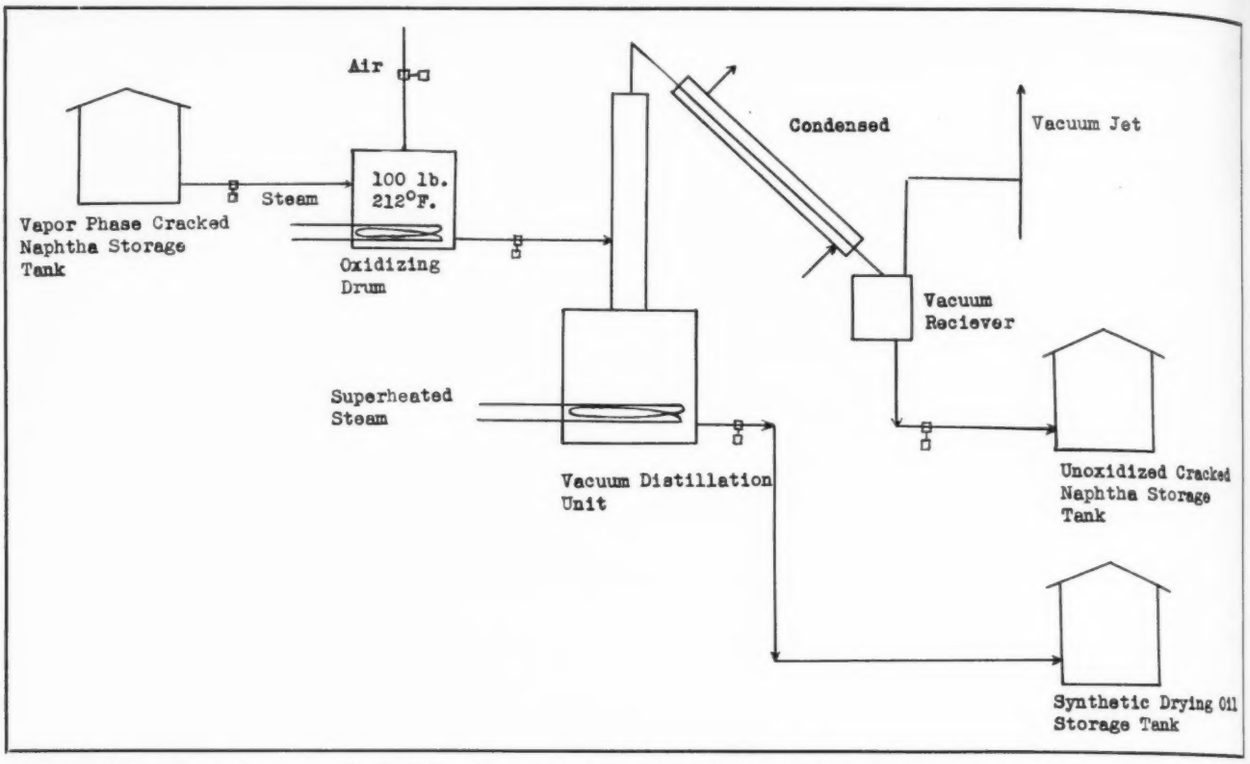



Fig. 2. Flow sheet of proposed plant for the production of synthetic drying oil from vapor-phase cracked naphtha

oxidation and rerunning costs, the cost of producing the synthetic drying oil would be approximately four cents per gallon. As linseed oil is around 45 cents per gallon, it would appear that the production of synthetic drying oils from cracked naphtha offers possibilities that petroleum refiners should not overlook.

A flow sheet of a proposed plant for the production of a synthetic drying oil from vapor-phase cracked distillate is shown in Fig. 2.

The annual production of drying oils (linseed, tung, etc.) in this country is approximately 800,000,000 lb. and the market price for this product is approximately $65,000,000. These figures make it apparent that a large market exists for a cheap competitive drying oil.

# Asphalt Mining and By-Products Industry In Sicily

THE largest deposits of asphalt rock in Italy are in Ragusa, Sicily. According to scientific publications, this rock has a hydrocarbon content of from eight to ten percent.

Production in Sicily has been declining for many years, decreasing from 171,097 metric tons in 1913, down to 49,645 tons in 1933, the last year for which official statistics are available. This decline is due to changes in street-paving methods, and competition from petroleum asphalt.

Attempts have been made to employ bituminous rock in Sicily for the extraction of oil. During the World War, a company, the A.B.C.D. (Asfalti, Bitumi, Catrami e Derivati—Rome) was formed at Ragusa, subsidized by the government, and oil extraction was begun from the products of the quarries there. The original estimate of mineral oil production from the Ragusa province was 200,000 tons a year, with enough raw material to last for 100 years, using material with bitumen content of less than eight percent. The oil yield per ton of asphalt was calculated at four percent by weight, which would require 5,000,000 tons of rock per year for the production of 200,000 tons of oil. Later estimates of the amount of rock available in the Ragusa province, based on calculations made after drilling, showed that there were nowhere near the 500,000,000 tons necessary for an annual production of 200,000 tons of oil for a period of 100 years. It was estimated that the rock deposits would be exhausted in seven or eight years if such an amount of oil were produced annually.

Production actually has averaged only a few thousand tons a year, because of technical and economic difficulties. An attempt was made to extract products from the crude oil produced, which was also a failure, although this might have been foreseen from the results of experiments over a period of years conducted by the asphalt industry in Scotland.

# Bureau of Mines Reports on Natural Gas Reserves of Central Michigan

A CAREFUL analysis of production and subsurface data pertaining to the Michigan "Stray" sandstone horizon of Central Michigan, made by the United States Bureau of Mines, Department of the Interior, indicates that proved and semi-proved gas reserves warrant supplying local market requirements, both domestic and industrial, and planning pipe line projects to Michigan's smaller cities, compatible with the known reserves, allowable gas withdrawals, and monetary investment in transmission and field pipe line facilities. Projects involving large investment of money, however, for transportation facilities to considerable distances should not be initiated until gas reserves and availability of these reserves are sufficient to warrant them.

The total proved and semi-proved initial recoverable gas reserves from the central Michigan area, based upon a correction factor of 90 percent and an abandonment pressure of 125 lb. per sq. in. absolute at the well head, was estimated to be approximately 48,200,000,000 cu. ft. of gas. About 6,000,000,000 cu. ft. had been withdrawn from the gas fields prior to February, 1936. The proved and semi-proved net recoverable reserve was, therefore, approximately 42,200,000,000 cu. feet.

These conclusions, based on data as of February 1, 1936, are contained in a report submitted to the Geological Survey Division, Department of Conservation, State of Michigan, at the request of that department and the Michigan Public Utilities Commission. The area studied by E. L. Rawlins and M. A. Schellhardt, engineers of the Bureau of Mines, comprises the Clare, Vernon, Broomfield, Austin, and Hinton-Millbrook-Belvidere gas fields; the Vernon and Ferris-Crystal oil and gas fields; and gas-producing areas in Home, Richland, Day, and northern Ferris Townships.

The development of the natural-gas industry in Michigan has been related closely to the development of oil production, which is comparable with that in most of the eastern oil-producing states. The development of oil production will continue, especially in the central Michigan Basin, and as wells are drilled to deeper horizons in the search for oil, more knowledge will be obtained of the gas reserves in formations above the oil-bearing horizons. The Michigan stray sandstone members are irregular, not only within the areal extent of general occurrence in central Michigan, but also within productive areas of individual fields. The pay horizon in the Michigan stray sandstone is comparatively thin, the productive areas of individual gas fields are relatively small, and the gas reserves per acre in the productive area are comparatively low.

Oil and natural-gas fields in central Michigan occur consistently in northwest-southeast trends. Based upon available production and subsurface data, it is thought that additional gas reserves from the Michigan formation in central Michigan will be obtained by (1) the extension of present proved gas fields; (2) development of new gas fields, and (3) gas production from sandstone members higher stratigraphically in the Michigan formations than the basal member of that formation. Wells that produce from stratigraphically high sandstone members in the Michigan formation have been drilled on the "flanks" of gas-field structures in central Michigan fields. Only rough estimates can be made of the gas reserves in such members but it seems probable that these reserves will be found in comparatively small "pools," and their commercial importance will depend considerably upon the availability of gas from the wells, the sizes of the pools, and their proximity to the fields producing from the lower Michigan stray sandstone members.

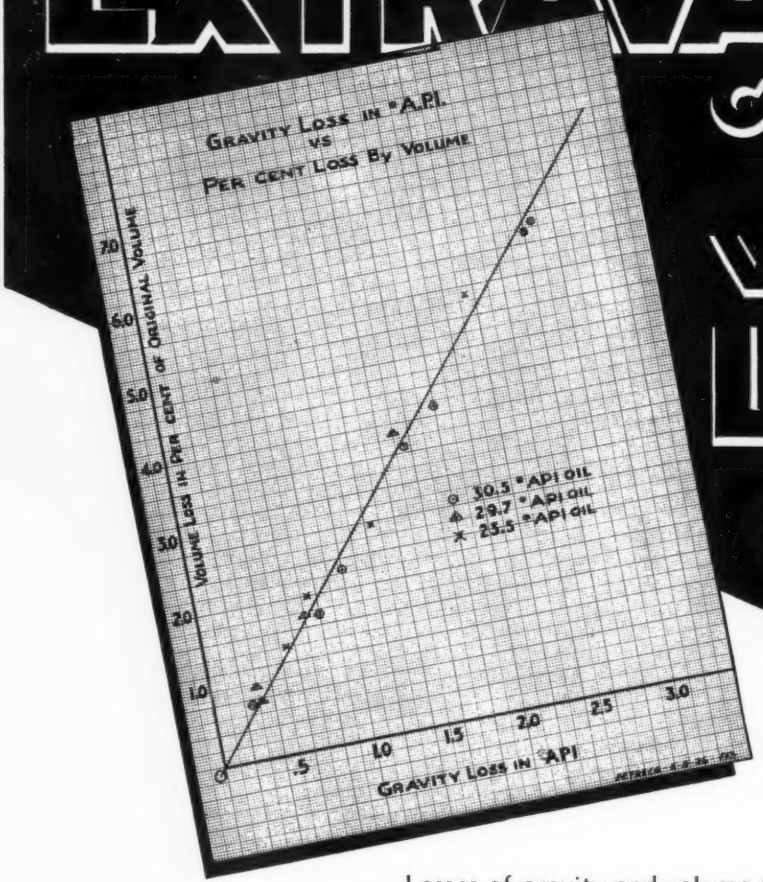
It has been estimated that future development of the proved gas fields might result in an additional gas reserve of approximately 12,000,000,000 cu. ft., and development of new gas fields, based upon present known structural conditions, in an additional recoverable gas reserve of approximately 21,000,000,000 cu. feet. These estimates are based on an abandonment pressure of 125 lb. per sq. in. at the well head.

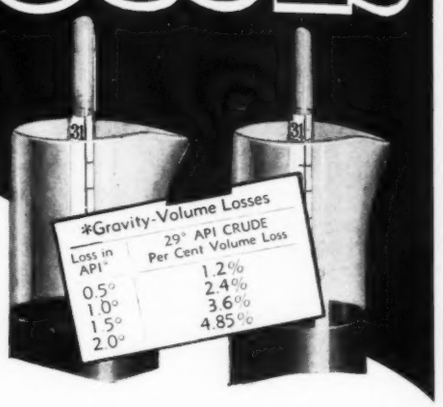
Studies of back-pressure data that have been obtained from gas wells in central Michigan suggest that with continuation of present indicated decline of delivery capacities of the wells, commercial production of gas will not be feasible at abandonment pressures for the field less than 125 lb. per sq. in. absolute, and in some fields commercial gas production possibly will not be feasible at abandonment pressures less than 200 lb. per sq. in. absolute. The production of natural gas from the Michigan stray sandstone depends upon economic factors common to the natural-gas industry. This is particularly true because of the comparatively low gas reserve per acre in most of the present proved fields and the comparatively small areal extent of the fields. The magnitude of the natural-gas reserve and the availability of this reserve, or the rate at which gas can be produced from the reserve without damaging the wells or the productive formation, should be correlated when considering the feasibility of pipe line projects for market requirements.

For the purpose of the report, reserves of gas in oil-bearing formations were considered mainly from the standpoint of the effect of the availability of the gas on the requirements for gas from the Michigan stray sandstone. Large quantities of the gas already have been produced from the oil-bearing formations, part of which contained sulphur. Oil production practices are not favorable to the use of the gas for domestic and most industrial requirements.

The Michigan Department of Conservation, in coöperation with the Michigan Public Utilities Commission, printed Report of Investigations 3313, Extent and Availability of Natural-Gas Reserves in Michigan "Stray" Sandstone Horizon of Central Michigan, by E. L. Rawlins and M. A. Schellhardt of the Bureau of Mines staff. Single copies of a limited edition are available without charge from the Information Division, U. S. Bureau of Mines, Washington, D. C.

# Avoid These EXTRAVAGANT GRAVITY AND VOLUME LOSSES




Losses of gravity and volume that result from inefficient handling of crude production on the lease frequently range up to 15¢ per barrel at the well—staggering sums when computed on the basis of annual production of a well or lease.

While the loss of gravity is manifest through the reduction in price of 3¢ or 4¢ per degree API, the loss in volume is not so readily apparent. Yet the monetary loss due to shrinkage in volume frequently is as large as that due to gravity loss.

The accompanying chart serves to bring these losses more clearly into view. It represents actual case records on three different crudes, and shows the relationship between gravity loss and volume loss*. It reveals that a loss of 2° API in handling a 29° API oil on the lease, in this instance amounting to 7¢ per barrel, will be accompanied by a loss in volume of 4.85%, which is equivalent to 5¢ per barrel for the same crude; a total of 12¢ per barrel on the total production of this lease.

This is but one of many instances where gravity and volume losses mount to staggering sums every year. Both can be avoided by Petreco Electroflow Dehydration.

*Petreco engineers can determine the amount of gravity and volume lost in handling the production from any well or lease. Their services are available to operating oil companies at all times without cost or obligation.*

PETROLEUM RECTIFYING COMPANY OF CALIFORNIA

General Offices: 530 West Sixth Street, Los Angeles, California

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PETRECO

**BURDETTE BLUE,** president of the Indian Territory Illuminating Oil Company, has returned to Bartlesville, Oklahoma, following a trip to the East.

**H. K. V. TOMPKINS** again has become associated with **J. PAUL GETTY** as vice-president of the latter's companies east of California. He is in charge of development and operations, with headquarters in Tulsa, Oklahoma.

**F. G. RAPPOPORT,** general manager in Venezuela for British Controlled Oilfields, spent his vacation in England, returning to Venezuela recently.

**E. O. BUCK** has resigned as chairman of the engineering committee of the Conroe (Texas) Operators' Committee, to devote his time to consulting engineering work with offices in Houston, Texas. **FIELD DAVIS,** who has been with the Tretolite Company, and who at one time was a petroleum engineer with the Stanolind Oil and Gas Company, has been named to succeed Buck.

M. H. SHANAHAN

**M. H. SHANAHAN,** who recently was made assistant manager of the Continental Oil Company's production department, has been identified with the oil industry for 17 years. After attending the University of Colorado he joined the organization of Keoughan-Hurst Drilling Company in 1919. He remained with this firm until it was reorganized following a merger with the Mutual Oil Company and became known as the Elk Basin Consolidated Petroleum Company. Later that company was merged with the Continental.

**GRIFFIN HALSTEAD,** vice-president of the Galena Oil Company, Cincinnati, Ohio, passed away last month at the age of 54. He was a prominent figure in the oil industry for many years, and is survived by his widow, three daughters, and a son.

**VAN D. BENNETT,** of the British American Oil Producing Company, Tulsa, Oklahoma, has been spending considerable time recently in the fields of Montana and in the Turner Valley field of Calgary, Canada.

H. H. POWER

**H. H. POWER** on October 1st took over the chairmanship of the department of petroleum production engineering at the University of Texas. He has been chief production engineer of the Gulf Oil Corporation (Gypsy Oil Company) with headquarters at Tulsa, Oklahoma. Undergraduate studies were taken by Power at Stanford University and State College of Washington, graduating from the latter in 1919 with a degree of B.S. in chemical engineering. In the spring of this year he was granted a professional degree of chemical engineering by the same institution. He took graduate studies in petroleum engineering at the University of California in 1926-27, receiving the degree of M.S. He was a junior engineer with the Denver Gas and Electric Company and the Empire Companies from 1919 to 1922. From 1922 to 1926 he was valuation engineer (oil and gas) of the U. S. Internal Revenue Bureau. He became production engineer with the Gulf in 1927 and held that position until 1930, at which time he was made chief production engineer.

**C. H. RANKIN,** production foreman in the Jesse area of Oklahoma for the Continental Oil Company, has been transferred to Shiprock, New Mexico, and made superintendent of that district. He succeeds to the post made vacant by the recent death of **E. M. RAMSEY** in an automobile accident. **J. M. JONES,** who has been production foreman in the Borger, Texas, district, goes to the Jesse area to succeed Rankin there.

**S. A. HARTWELL, JR.,** has returned to Oil City, Pennsylvania, headquarters of the Pennsylvania Grade Crude Oil Association following a year and a half abroad as European manager. Hartwell is now the association's assistant secretary. **S. F. PRATT** has been made European manager.

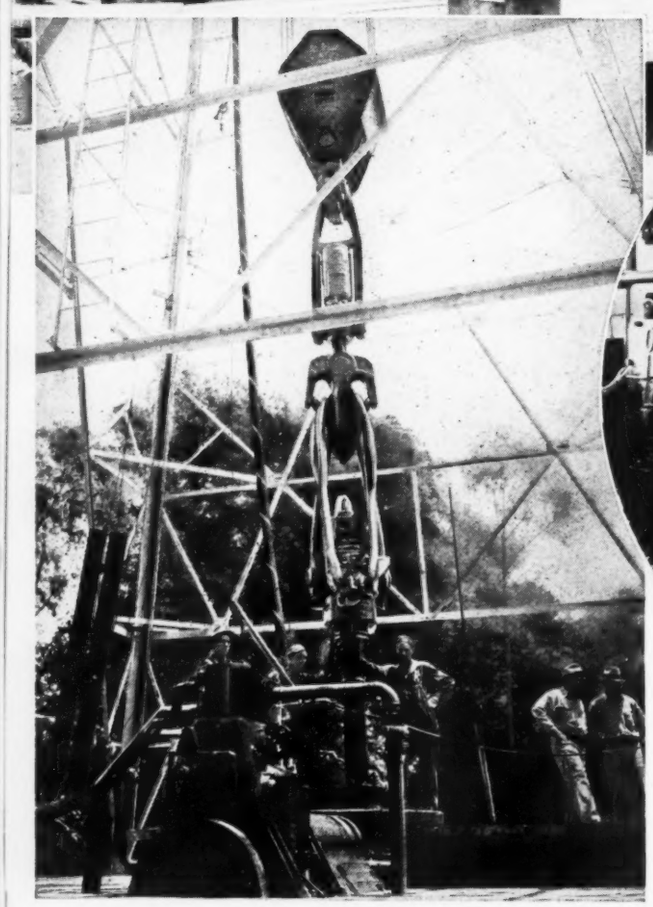
**IRVIS W. BUTTERFIELD,** petroleum engineer and geologist, has joined the staff of the Graydon Oliver Organization, and will have his headquarters for the time being at least at Ventura, California. In the past he has been affiliated with the Associated Oil Company and the Richfield Oil Company.

**DANA HOGAN,** well-known California oil operator, has returned from Europe, where he has been on business the last several months.

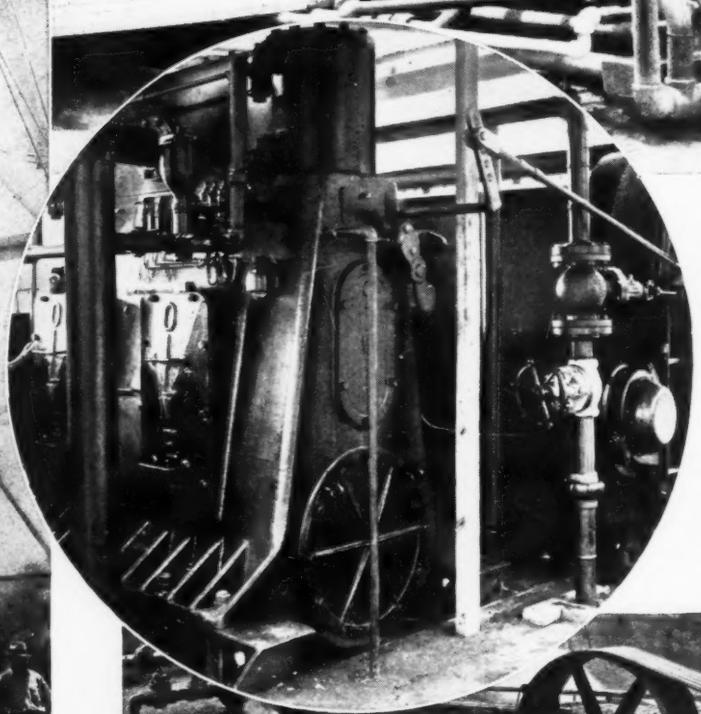
**F. C. BOYD,** formerly drilling superintendent of the Union Oil Company, has been made general superintendent of drilling, with headquarters at Santa Fe Springs. **TED MILES,** formerly assistant general superintendent, Northern Division, has been appointed superintendent of production, Valley Division, with headquarters at Bakersfield. **W. H. WATKINS,** production foreman, has been named superintendent of production, Coast Division, with headquarters at Orcutt. **W. S. EGGLESTON,** chief development engineer, has been made chief petroleum engineer with headquarters at Los Angeles.

**GEORGE ELLIOTT,** petroleum engineer, Alberta, Canada, was a recent visitor in the Mid-Continent area.

# SAVE



(Above) *This complete heavy-duty steam rig is operating economically on a deep test near Beaumont, Texas. Shown here are 3 major pieces of "OILWELL" equipment, the 80" Streamline Traveling Block, 150 ton Swivel and Rotary Drilling Unit (Oilbath Rotary direct-driven by small vertical twin-cylinder steam engine).*



(Above) *A modern oil boiler plant (Gulf Coast ing two "Oilwell" 125 H 350 lb. W. P. Boilers, a Wheeler Separately Fired heater and an "Oilwell" water Heater and Purifier feedwater is heated to 210 in direct contact with haust steam. There is standing saving in fuel water consumption.*

(In Circle) *This 11" x 12" tical Twin Cylinder Engine in service near mont, Texas. A double sprocket is used to drive hoist and an extended sprocket is used to drive sand reel.*

(At Right) *This 7¾" x 18" power slush pump is driven by a 7¾" x 7" vertical twin-cylinder steam engine on a well in the Fitts Pool, Oklahoma.*

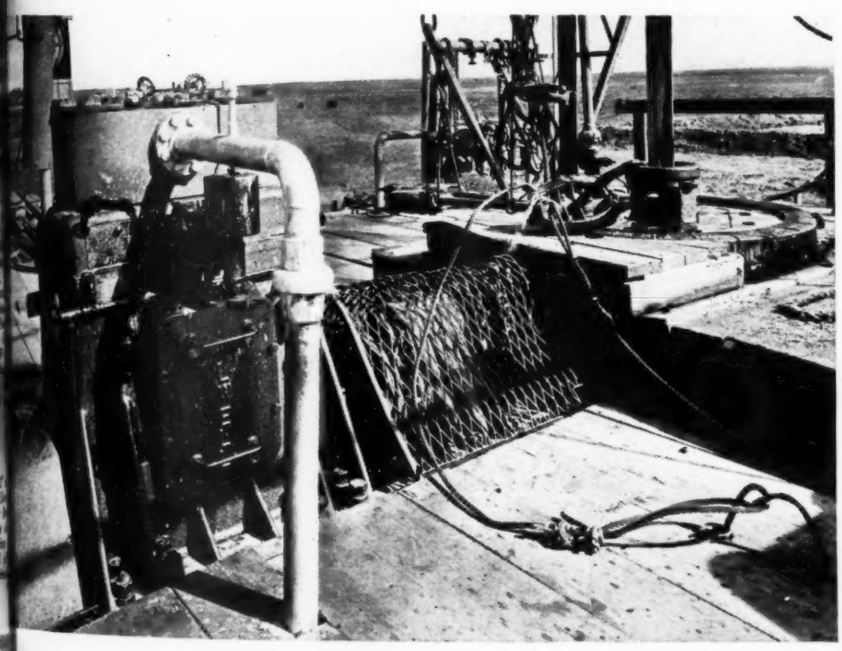
# WITH STEAM...

## THE "OILWELL" WAY!

GREAT reserve power . . . flexibility . . . reliability . . . speed — all these have kept steam on top as the preferred power for drilling.

Modern steam rigs are economical and efficient. Steam is firmly entrenched as the prime source of power for rotary drilling in the oil country.

"Oilwell's" new and advanced types of steam rigs are unexcelled for reliable and economical drilling to any depth.



*This rotary drilling unit consists of a 27½" Oilbath Rotary direct-driven by a 7¼" x 7" vertical twin-cylinder steam engine. It is in service on a deep test near Houston, Texas.*

## USE 61% LESS FUEL

***Use modern "OILWELL" drilling principles and machinery and you will get these savings in fuel consumption.***

| RIG COMBINATION NO. | EQUIPMENT USED ON RIG | FUEL OIL CONSUMPTION BBLS. PER DAY | SAVINGS OVER FUEL OIL CONSUMPTION OF CONVENTIONAL RIG (NO. 1) |
|---|---|---|---|
| #1 | Conventional Rig equipped with Direct-Acting Slush Pumps, WITHOUT Feedwater Heater Pump or Superheater | 100 | ..... |
| #2 | Conventional Rig equipped with Direct-Acting Slush Pumps, WITH Feedwater Heater Pump, but WITHOUT Superheater | 85 | 15% |
| #3 | Conventional Rig equipped with Direct-Acting Slush Pumps, WITH Feedwater Heater Pump and Superheater | 76.5 | 23½% |
| #4 | Advanced Rig WITH Feedwater Heater Pump and Superheater and also WITH a Power Slush Pump driven by an "OILWELL" No. 7 Steam Engine | 53.5 | 46½% |
| #5 | Advanced Rig WITH Feedwater Heater Pump and Superheater and also WITH a Power Slush Pump driven from the extended shaft of an "OILWELL" No. 12-D Engine, the double center-drive sprocket of which is used to drive the Draw Works and Rotary | 46 | 54% |
| #6 | Advanced Rig WITH Feedwater Heater Pump and Superheater and also WITH an "OILWELL" Rotary Drilling Unit and a Power Slush Pump driven by a No. 7 Steam Engine | 45.5 | 54½% |
| #7 | Advanced Rig WITH Feedwater Heater Pump and Superheater and also WITH an "OILWELL" Rotary Drilling Unit and a Power Slush Pump driven from the extended shaft of a No. 12-D Steam Engine which drives the Draw Works with its center-drive sprocket | 39 | 61% |

**OIL WELL SUPPLY COMPANY**

*Subsidiary of United States Steel Corporation · Branch Stores in All Oil Fields*

**OILWELL"**

# LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

*Confirmed Golfer* (to players ahead): Pardon me, gentlemen, but would you mind if I played through? I have just heard that my wife has been rushed to the hospital for an operation.

* * *

*Judge:* Didn't I tell you the last time you were here that I didn't want to see you here again?

*Prisoner:* Yes, Your Honor, that's what I told these policemen, but they wouldn't believe me.

* * *

The hostess was pressing her guests to provide entertainment.

"Isn't there any instrument you can play, Mr. Jones?" she asked.

"Not any away from home," he replied.

"What do you play at home?" she inquired.

"Second fiddle," murmured Jones solemnly.

* * *

The minister called at the Jones' home on Sunday afternoon, and little Willie answered the bell.

"Pa ain't home," he announced. "He went over to the golf club."

The minister's brow darkened, and Willie hastened to explain: "Oh, he ain't gonna play any golf, not on Sunday. He just went over for a few highballs and a little stud poker."

* * *

*Classified Ad:* If the person who stole the jar of alcohol out of my cellar will keep same and return grandma's appendix, no questions will be asked.

* * *

"Why wouldn't you go to the masquerade with Jim last night in your Hawaiian costume?"

"Well, I found out he was going as a harvest hand."

* * *

*Sally:* What did the doctor say when he was late on that rush call?

*Jack:* Hello, baby!

"Lady," said the beggar, "could you gimme a quarter to get where me family is?"

"Certainly, my poor man," she replied, "Where is your family?"

And as he edged away he answered, "At de movies."

* * *

### Kind-hearted

Outside the toy animal factory the storm raged furiously. Inside the machines were silent. The enraged owner dashed up to the night foreman. "Why aren't you turning out our usual quota of toy animals?"

The foreman drew himself up to his full height as he replied, "I would not turn out a dog on a night like this."

—*Ohio Green Goat.*

* * *

"Give this little girl a great big hand," said the cannibal's small daughter as dinner was being served.

* * *

Miss Sophia Jones tripped into the lawyer's office.

"Cain't ah sue dat no good Rastus Smiff fo' somepin', mister? He promised to marry me, dat he did, an' yestiddy he done 'loped with another gal."

"Promised to marry you, eh?" mused the lawyer. "Well, have you anything in black and white to show for it?"

"No, suh," replied Sophia. "Jes' black is all."

* * *

*Joe:* I can't eat this soup.

*Waiter:* Sorry, I'll call the manager.

*Joe* (to manager): This soup, I can't eat it.

*Manager:* I'll take care of it at once. Call the chef.

*Joe* (to chef): Dammit, I can't eat this soup.

*Chef:* What's the matter with it?

*Joe:* Nothing, only I ain't got a spoon.—*Cornell Widow.*

"You certainly were drunk last night!"

"Go on, tell me something I don't know."

"Sure—you're married."

—*Penn Punch Bowl.*

* * *

*Babe:* Where were you last night?

*Sheik:* With you, babe.

*Babe:* Thanks, I wasn't sure. Then you're the fellow dad's looking for.

* * *

*Father:* My son sure is broad-minded.

*Ditto:* That's all my son thinks about too.—*Indiana Bored Walk.*

* * *

"Sir, may I have your daughter for my wife?"

"Bring your wife around and I'll see."—*Missouri Showme.*

* * *

"Will you marry me?"

"No, I can't, but I'll always admire your good taste."

—*Temple Owl.*

* * *

"Does she have her own way?"

"Does she? Why, she writes her diary a week ahead of time."

* * *

It was a dark alley in one of the worst parts of the town. Three men were waiting. One of them pulled a slouch hat down over his eyes and said: "D'ya see him?"

Another took a quick look around the corner. "Yeah, here he comes!" he hissed.

The man with the slouch hat picked up a short thick section of pipe. Another took a heavy wrench, and the third grabbed a smaller wrench that was none the less effective in close quarters.

"All right, fellers, let's go," one whispered.

And thus, when the boss got around the corner he found his three plumbers busily at work.

# "But, how can I KNOW

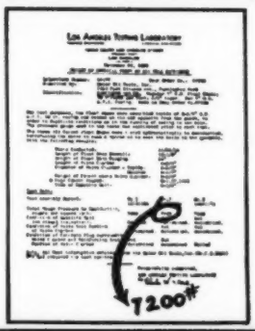
**. . . what to look for in selecting equipment for Guiding, Floating and Cementing my casing?" It's really as easy as A, B, C. Just make sure that the equipment you choose contains the 3 Points explained below. It must possess ALL THREE and they must be in BALANCED COMBINATION.**

**It will take only a few minutes to read about them. Why not settle any doubts, once and for all, and KNOW that you too will enjoy peace of mind, safety, savings, and successful results?**

## POINT NO. 1 — IS IT STRONG ENOUGH TO BE SAFE?

And the answer is—"If cementing equipment is as strong as these tests show Baker Cement Equipment to be, you are entirely safe."

Baker Cement Float Shoes are made from seamless steel, into which are anchored plug and valve assemblies made of "Baker Formula" concrete, and Bakelite.



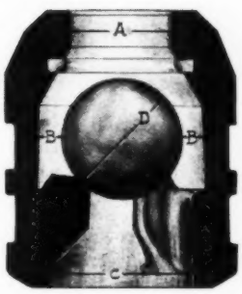

Refer to the illustrations which show the results of tests by reputable independent Testing Laboratories, made upon shoes selected at random from stock.

The entire assembly is safe far beyond the extreme demands in the field in the deepest wells, which proves Point No. 1, and permits us to read on to . . .

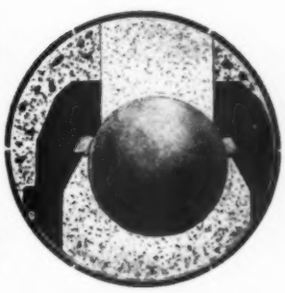
## POINT NO. 2 — HAS IT AN EFFICIENT VALVE ACTION?

And the answer, "If the cement can be put away freely, and positively held outside the shoe, you are SURE about valve efficiency."

Baker Cement Equipment has a valve assembly made entirely of Bakelite, with circulation passageways large enough to permit free flow of cement slurry, but small enough to retain a "wash down" action which is so often an important feature. Illustration to right.



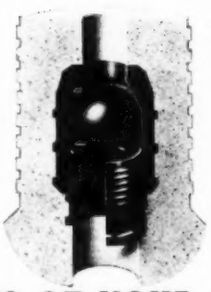

And after the cement has been placed outside the shoe and up around the casing, the Bakelite ball (which floats in cement slurry or ordinary rotary mud) instantly seats when pressure is reversed. Whether the back-pressure is low or high, this BAKELITE ball double-seals against a rubber ring and a Bakelite seat to provide a positive, leak-proof seal.



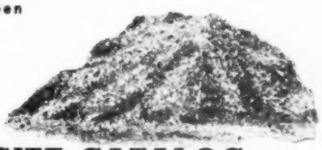
## POINT NO. 3 — Can it be COMPLETELY & EASILY Drilled up?

And the answer, "The entire plug and valve assembly are made only of "Baker-Formula" Concrete and Bakelite."

It is easy to visualize from illustration to right how rapidly and smoothly the plug and valve assembly drill out of any piece of Baker Cement Equipment. The concrete drills up into small uniform fragments, and the Bakelite valve cage is held in position for fast grinding-up by the bit.



And in minimum time the internal construction is reduced to small particles which circulate out of the hole with rotary mud. You have lost no time, the same bit used for drilling out the shoe is not dulled, but is ready to make additional footage, with no danger of being deflected by metal to start an off-vertical hole. Or, if desired, you can CORE IMMEDIATELY BELOW THE SHOE with no trouble from metal or other objectionable fragments left on bottom after the shoe has been drilled out.



LOOK ON PAGES 169 TO 178 OF YOUR 1936 COMPOSITE CATALOG

# BAKER CEMENT EQUIPMENT

*for guiding—floating—cementing casing*

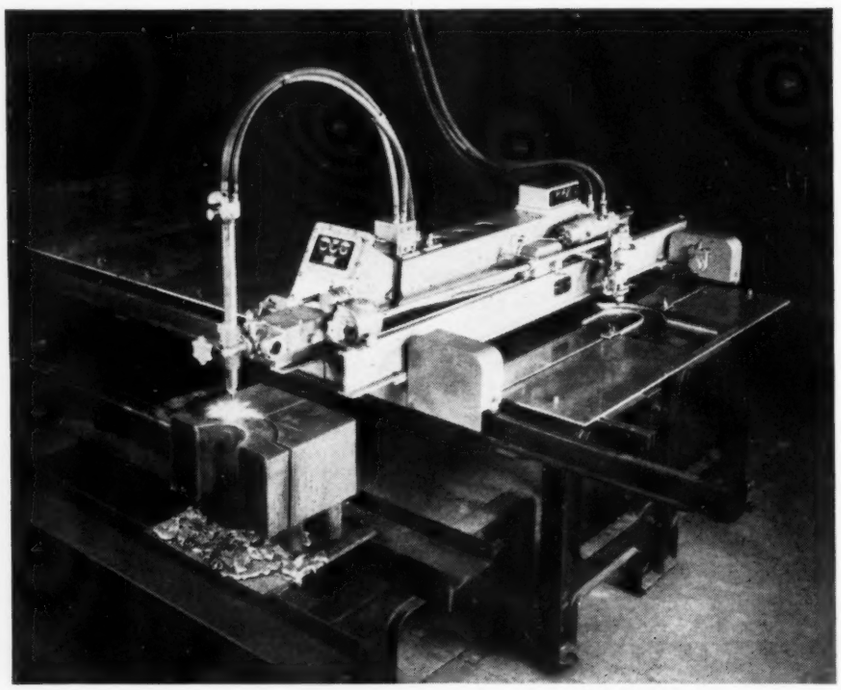
## BAKER OIL TOOLS, INC.

POST OFFICE BOX 71, HUNTINGTON PARK, CALIFORNIA

COALINGA • TAFT • HOUSTON • OKLAHOMA CITY • TULSA • NEW YORK

# MACHINERY and EQUIPMENT

## Oxweld Shape Cutting Machine



INTRODUCTION of the new Oxweld Type CM-12 shape-cutting machine by The Linde Air Products Company, 205 East 42nd Street, New York City, makes available to the metal-working industries a machine designed to give the accuracy and range of work demanded more and more of the flame cutting processes. Its precision, simplicity, and economy of operation will widen the scope of shape-cutting, the manufacturers state. The flexibility of this machine allows almost limitless possibilities for its use, it is said. It is powerful and has a great cutting capacity. Any shape, from the simplest to the most complicated, can be accurately produced either automatically with templets or guided by hand, the makers claim. The immediate transfer of motion from one end of the machine to the other is a factor in assuring precision in all cutting operations.

In addition to cutting shapes of all description, the machine will cut straight lines automatically in any direction and at any bevel. Cuts as long as 144 in. are possible and an important feature lies in the fact that straight line cuts can be made at any desired angle in the horizontal plane. A special circle cutting attachment also is provided, thus enabling the automatic production of circles from two in. to 24 in. in radius. Still another feature is that of multiple cutting. The apparatus is designed to carry from two to five blowpipes that can perform multiple cutting operations under all the conditions possible with a single blowpipe.

The features of design and construction that make possible the accomplishments of this new shape cutting machine typify the trend in modern machine development. Alloys have been utilized to establish an ideal strength-weight ratio combined with the necessary stability and rigidity of construction. Complete enclosure of the vital working parts insures correct lubrication and freedom from maintenance.

The motor is rated at 1/3 horsepower. The speed range of the CM-12 is from 1½ in. to 75 in. per minute.

All important controls have been duplicated so that operation is possible from either blowpipe or tracing position.

The blowpipes used have been constructed to give greater flame stability and increased economies in cutting. Material up to 12 in. in thickness can be easily handled; for heavier cuts a special blowpipe is available.

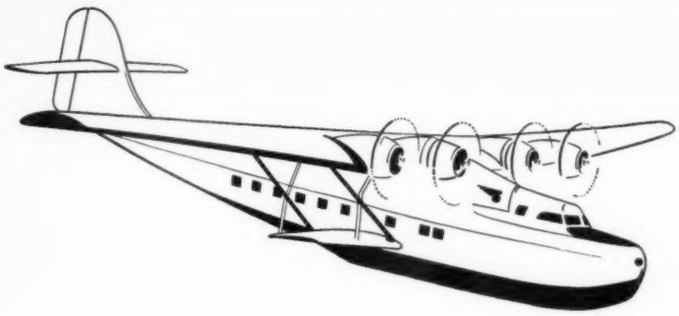
The sensitive tracing mechanism, accurate scale calibrations, and freedom from friction and vibration, incorporated as a result of careful study and workmanship, make precision cuts a routine accomplishment.

---

## Type GMA Organic Vapor Canister

THE Mine Safety Appliances Company of Pittsburgh, Pennsylvania, has announced that its Type GMA Organic Vapor Canister for respiratory protection against organic vapors when the total concentration does not exceed 2 percent by volume in air has received the approval of the United States Bureau of Mines. The approval was granted on the basis of meeting the requirements of the Bureau of Mines Schedule 14D.

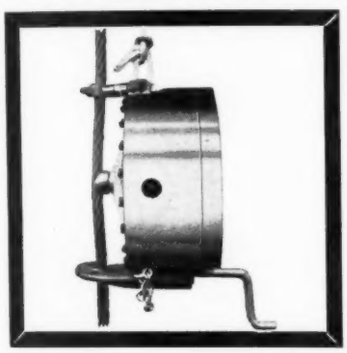
This marks the first time that any mask of this type has been granted such approval, the makers state, and hereafter all Type GMA Canisters made by the Mine Safety Appliances Company will bear the label of Approval No. 1415.



*Presenting*

# "THE CLIPPER"

## THE WEIGHT INDICATOR WITH LABORATORY ACCURACY AND OIL FIELD RUGGEDNESS



**"The Clipper" is the latest advancement in weight indicator design made to meet the ever-increasing demands of modern drilling for accuracy, strength, sensitivity and flexibility. It sets a new standard for precise measurement.**

**Pressure in "The Clipper" indicator is transmitted by a closed fluid column that *eliminates errors* that might arise from friction and metal fatigue. The full weight on the indicator is read directly in pounds or in points, regardless of the size of the load, from spudding in to pulling tubing.**

**"The Clipper" is an instrument that is in the van of scientific oil field development and will insure greater accuracy in all oil field operations, including shallow or deep drilling, fishing, and in all phases of productions, including pulling rods and tubing, setting packers, liners and casing. All parts are of the finest workmanship and carefully balanced, making the indicator instantly responsive to slightest changes in load. "The Clipper" is truly as sensitive as a ship's compass. Two sensitivity controls, adjustable at will, control the over-throw or wig-wagging of indicator hands. This makes for precise reading on the derrick floor during all operations.**

**Mechanical compensators automatically correct variations in readings formerly caused from temperature changes.**

**This latest product of Martin-Decker Corporation has been aptly named "The Clipper" for it is compact, self-contained, and is enclosed in a water-tight, streamlined aluminum case. It has no projections or angles to hang up on tong lines, etc. It is sturdy and light in weight, actual weight only 47 lbs., and occupies less than a square foot of space. Of course, the Clipper Tool-pusher is essentially an instrument to be used where a chart record is not required.**

**An absence of exposed connections prevents tampering. Filling or pumping up the indicator with fluid in the field is eliminated as each instrument is vacuum loaded and sealed at the factory. A simple safety lock on the top hook prevents snapping or jerking the indicator off the dead-line.**

**"The Clipper" can be carried in a car seat. It is in operation immediately upon being clamped on the dead-line. Installation requires only a few seconds.**

**Truly the finest and most accurate Weight Indicator yet offered to the oil industry, it is a triumph in precision and ruggedness.**

THE WEIGHT INDICATOR

**MARTIN DECKER CORP.**

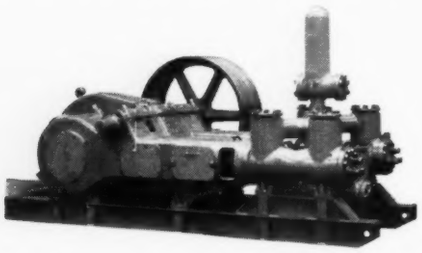
LONG BEACH CALIFORNIA

*San Joaquin Valley:* A. F. McQUISTON, Bakersfield, California
*Mid-Continent Distributor:* REED ROLLER BIT COMPANY, Houston, Texas

- REQUIRES NO REFILLING OR PUMPING UP OF PRESSURE FLUID.
- IS NOT AFFECTED BY HEAT OR COLD.
- GIVES WEIGHT READINGS ACCURATELY, DIRECTLY IN THOUSANDS OF POUNDS AND IN POINTS.
- COMBINES BOTH THE REGULAR AND SUPERSENSITIVE WEIGHT INDICATOR IN ONE INSTRUMENT.
- EMBODIES CONTROLLABLE SENSITIVITY.
- LIGHT IN WEIGHT—"THE CLIPPER" WEIGHS ONLY 47 POUNDS, COMPLETE.

## National's New Series Heavy-Duty High-Pressure Slush Pumps Completed

THE speed of rotary drilling completions of late years has been greatly increased by the use of heavy-duty, high-pressure, steam slush pumps. To enable operators to get comparable results, profitably, where fuel and water are expensive, the National Supply Company, Toledo, Ohio, has developed a new series of power-driven slush pumps. The last of these high-duty pumps recently has been put on the market, making the line complete. It is known as the Ideal Type C-250—bore 7¼ in., stroke 15 in., with a power end rating of 250 hp. at 60 r.p.m., and a maximum fluid cylinder working pressure of 2500 pounds.



In the past, power-driven slush pumps generally have been handicapped by a limited power end capacity in comparison to their fluid ends, engineers of the National Supply Company state. The Ideal C-250, on the contrary, in common with the other pumps of its new line, has a power end equal to fluid end requirements. This enables it to give the same rapid, consistent drilling performance as the modern steam pumps of corresponding size, it is pointed out.

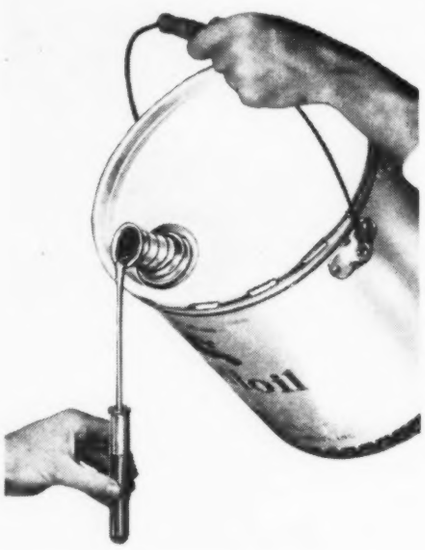
The Ideal Type C-250 Power Driven Slush Pump has the same design features that have demonstrated their utility on the other pumps of its series. One of the more important is the oiling system. Even at lower speeds, it is automatic and effective. Another feature is the effective exclusion of water and slush from the power end by a special baffle wall and plate assembly of distinctive design.

The mounting of the pinion shaft has found especial favor in the field, it is claimed. It is carried on four roller bearings, three SKF and one Timken, and gives a very desirable short overhang condition on both ends. This eliminates the tendency of pinion shaft failure due to bending load. The pump may be driven from either side, direct-connected or with V-belts. For convenience in removing V-belt sheaves, pinion shafts extensions are tapered. The fluid end has a high efficiency, and the design permits any imperfection to be readily visible from the outside of the cylinder.

The Ideal Type C-250 Power Driven Slush Pump weighs 28,975 lb. complete with extended skids less V-belt sheave. The other sizes of this series have been in the field since 1935. They are the Type C-350—7¾-in. bore, 20-in. stroke, with a rating of 350 hp. at 55 r.p.m.; and the Type C-150—6¾-in. bore, 12-in. stroke, with a rating of 150 hp. at 65 r.p.m. Ability to equal steam pump performance has been consistently demonstrated by both sizes, the makers claim.

## Tru-Pour Spout

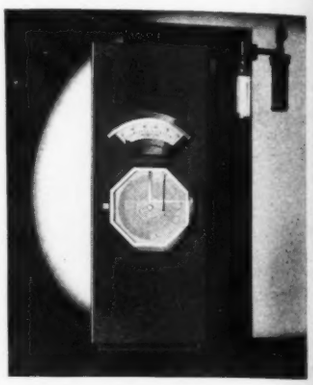
FACILITY in pouring small quantities of any kind of liquid from a completely filled 5-gal. pail is provided by an improved telescopic pour spout now available. The radius of the curve on which the sections operate has been reduced, giving the edge of the spout a longer projection over the rim of the pail, and permitting the regulation of the stream from a few drops to the full capacity of the spout. When completely telescoped, the spout nests into the opening at the base of which are perforations through which any surplus liquid drains back into the pail. The spout is provided with a cap that can be removed or replaced as often as desired. The cap effectively seals the contents against leakage and evaporation. An internal vent tube is fitted to the spout to permit the entrance of air, obviating the necessity of damaging the pail by puncturing holes. The tube insures full flow without gurgling and waste and speeds up pouring. This pour spout is widely used on various sized pails for holding either light and volatile or heavy, viscous liquids.



This equipment is manufactured by the Rheem Manufacturing Company, 4361 Firestone Boulevard, Southgate, California.

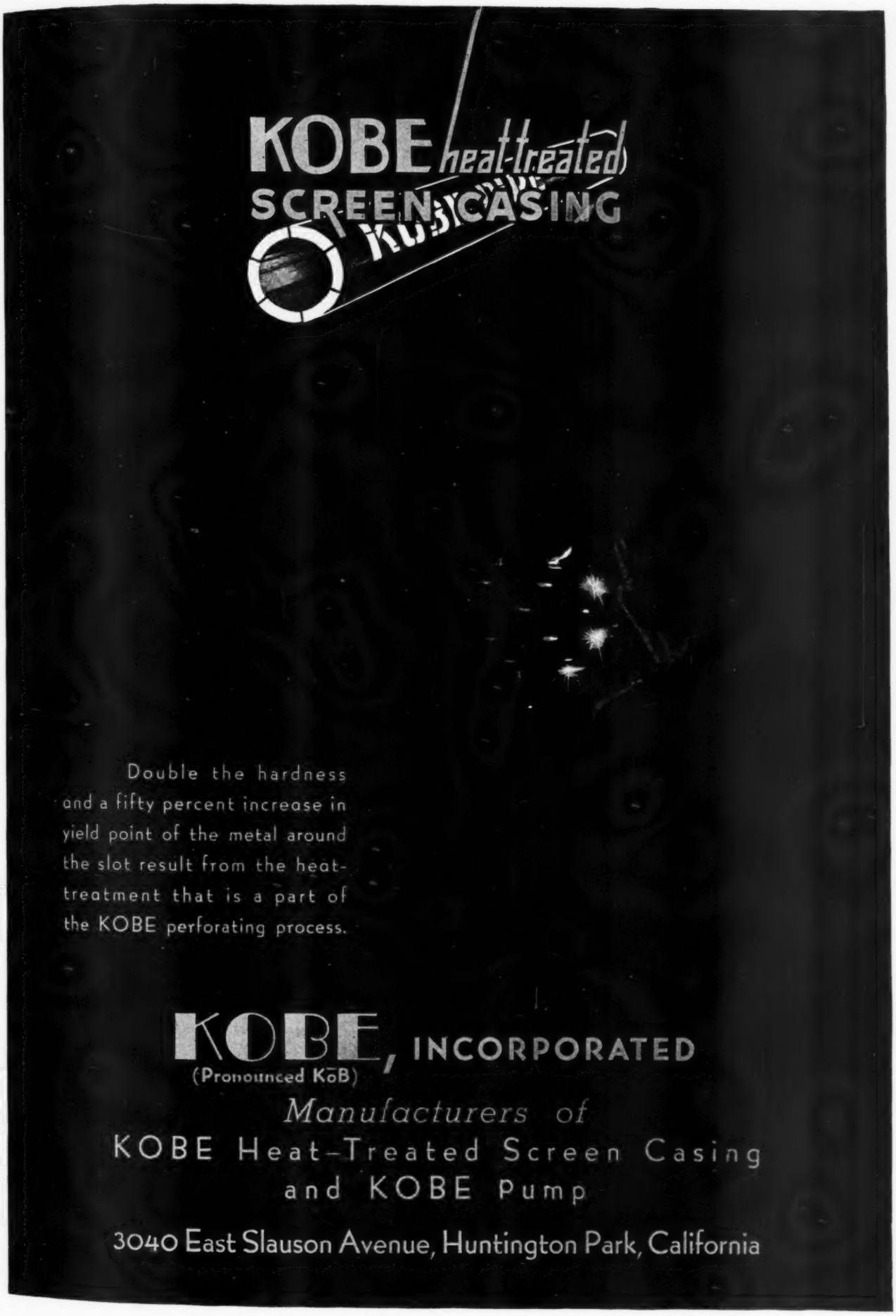
## Developments in Measurement of $CO_2$

THE latest developments in the measurement of $CO_2$ are incorporated in a new design of $CO_2$ meter. Experience gained in hundreds of plants over a period of many years has been utilized in building this improved analyzer, it is stated by the manufacturer, Republic Flow Meters Company, 2240 Diversey Parkway, Chicago, Illinois.



The percentage of $CO_2$ in the flue gas is measured by the Orsat method, which is the accepted standard for industrial practice, and the meter is built to duplicate, mechanically, this chemical analysis.

The meter is driven by a fractional horsepower electric motor and requires no water for its operation. There is no possibility of stoppage in the gas line as the instrument has a suction capable of drawing 14 in. of mercury, it is stated. The large caustic tank holds enough potash to last from four to six months. Temperature variations have no effect on the meter readings, the makers say. A filter in the gas line removes all $SO_2$ from the flue gas before it reaches the analyzer. A permanent, continuous, pen-line record is inscribed that may be read directly in percent $CO_2$, and arrangements of indicators and recorders may be made to fit any requirement. Related factors, such as steam flow, temperature, draft, pressure, etc., may be combined on one circular chart. The entire meter is ruggedly constructed with a minimum of moving parts. Data Book 403, giving complete description, will be mailed upon request.




Double the hardness and a fifty percent increase in yield point of the metal around the slot result from the heat-treatment that is a part of the KOBE perforating process.

KOBE, INCORPORATED
(Pronounced KŌB)

*Manufacturers of*
KOBE Heat-Treated Screen Casing
and KOBE Pump

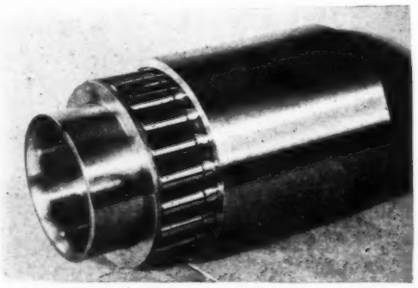
3040 East Slauson Avenue, Huntington Park, California

## Extended Range of Roller Bearings Introduced by Fafnir

A COMPLETE series of heavy-duty industrial roller bearings, made in an extended range of almost 100 sizes, is now being manufactured by The Fafnir Bearing Company, New Britain, Connecticut. The rated capacity of these bearings ranges from 10,000 to 500,000 lb., depending upon size, speed, and loading conditions. The series is said to cope fully with the severe service requirements of paper mills, steel mills, and other heavy metal-working machinery, rubber and oil field equipment, and the like.

In the widened range of bearing sizes, rollers of ¾ in., 1¼ in. and 1½ in. diameter have been utilized, in addition to the 1 1/16-in. diameter used in the bearings previously available. A choice of 18 different bores is now offered in bearings of this type.

A feature of these roller bearings is the large number of solid rolls that are incorporated in the cage assembly, thus making for increased load capacity. The cage itself is fabricated from specially form-rolled spacer bar stock,



with carburized and hardened end rings. Rollers are held in place and guided by spacer bars rather than by rivets through the rolls themselves, which of necessity tend to weaken the capacity of the roll. The spacer bars of the Fafnir cage are riveted to the end ring, and the accurate assembly of these bars keeps the rolls permanently aligned, the makers state.

The entire roller assembly is made with a fixed radial clearance to allow for the expansion that takes place when the inner ring is shrunk to the shaft, this being the standard method of mounting for the roller-type bearing. This clearance likewise permits the bearing to operate successfully and without impairment should temperature differentials occur in actual operation, that is, a certain amount of expansion due to heat, as is the case with dryer rolls, for example, can be taken care of without seriously affecting the relationship of the bearing parts.

All parts of these roller bearings are precision-ground, and held to extremely close tolerances. Complete specifications, including dimensions, tolerances, and load ratings, are available upon request.

## Model 40 Trackson Pipe Layer

THE pipe line industry has displayed interest in the new, improved Model 40 Trackson Pipe Layer, an all-purpose pipe handling machine, manufactured by the Trackson Company, Milwaukee, Wisconsin.

Designed and built for the McCormick-Deering Model T-40 TracTracTor, this machine will lay pipe on any kind of right-of-way, the manufacturers state. It is sturdily constructed for fast, efficient operation. All control levers are at the driver's fingertips and operations are simplified to a minimum.

The side boom is constructed of heavy H-beams with a cast-steel header designed for quick attachment and removal of blocks and stiff leg. It is substantially mounted to the rigid tractor frame and pivots on hardened steel, replaceable bushings. The legs of the boom are widespread, enabling it to take side pulls as well as those of lifting and lowering. When the boom has been raised to a vertical position, a safety stop prevents over-throw or bending.

Both load and boom lines raise and lower under power by means of worm driven winches. A separate clutch and brake on the load line drum enables the load to be lowered without power when desired. A special cross drive transmission permits load and boom lines to be raised or lowered separately or simultaneously.

The Trackson transmission, one of the many exclusive features on the Trackson

Pipe Layer, provides three speeds forward and reverse on both boom and load lines.

The Model 40 Trackson Pipe Layer is supplied complete with cable, blocks, stiff leg, and 2500 lb. counterweight.

The manufacturers will send full descriptive bulletin upon request.

# TESTS that assure *long service* under severe conditions

*For many years we have been using tests that assure accurate workmanship and long service*

***District Sales Managers***

W. E. Gibson, 801 Columbia Bank Bldg., Pittsburgh, Pa.
J. P. Cooney, 715-716 A. G. Bartlett Bldg., Los Angeles, Calif.
J. P. Steele, Petroleum Bldg., Fort Worth, Texas.

***District Offices***

South Chester Tube Co., 1708 Hudson Terminal Bldg., 30 Church St., New York, N. Y.
J. D. Swartz, 608 Beacon Bldg., Tulsa, Oklahoma.
E. L. Moseley, 2218 Mills St., Houston, Texas.
Burt S. Shafer, Southwest Representative, 4313 Fairfax Ave., Dallas, Texas, or 603 Petroleum Bldg., Fort Worth, Texas.

***District Warehouses***

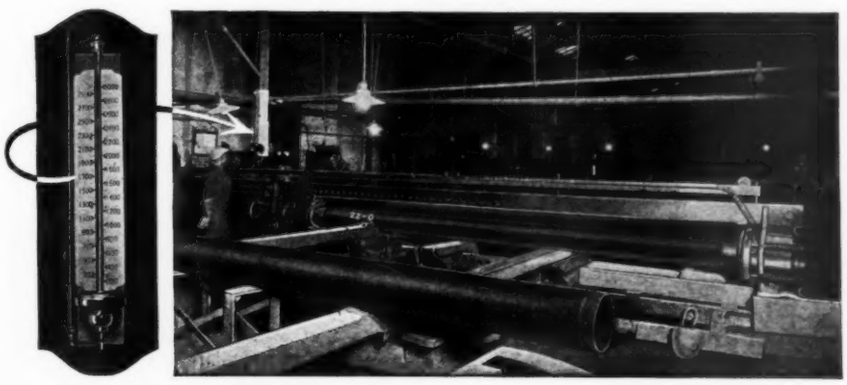
Houston, Texas; Thenard, Calif.; San Francisco, Calif.

***Distributors***

Western Supply Co., Tulsa, Okla., and Branches.
International Supply Co., Tulsa, Okla., and Branches.
Dunigan Tool and Supply Co., Breckenridge, Texas, and Branches.
Bridgeport Machine Co., Wichita, Kansas, and Branches.
Producers Supply and Tool Co., Marietta, Ohio; Fort Worth, Texas, and Branches.
Louisiana Supply Co., Sulphur and Brimstone, La.
Oil Field Equipment Co., San Antonio, Texas.
Okmulgee Supply Corp., Okmulgee, Okla., and Branches.
Stephen H. McCabe, 508 4th St., San Francisco, Calif.
Viking Automatic Sprinkler Co., 114 Sansome Street, San Francisco, Calif.
Herley Supply Co., 3006 Cherry Ave., Long Beach, Calif.
Barde Steel Co., Seattle, Wash., and Portland, Ore.
Star Drilling Machine Co., 550 Clinton St., Portland, Ore., and Akron, Ohio.
The Atha Supply Co., Zanesville, Ohio, and Mt. Pleasant, Mich.
United Pipe & Supply Corp., Charleston, W. Va., and Branches.
Bovaird & Co., Bradford, Pa.
Kane Supply Co., Kane, Pa., and Branches.
Prichard Supply Co., Mannington, W. Va., and Branches.
LeValley, McLeod, Kinkaid Co., Elmira and Olean, N. Y.

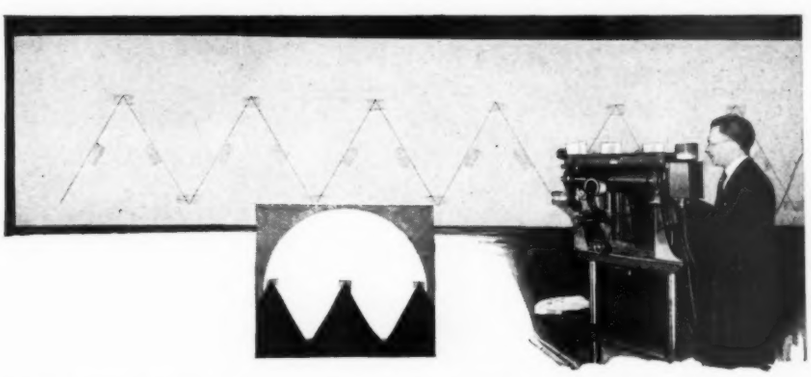
CAREFUL and exacting processes of manufacture and inspection *in the plant* assure unfailing service from Chester Casing, Pipe and Tubing *in the field*—where consistently dependable performance under severe conditions is fully appreciated.

Chester Products are as nearly perfect as modern machinery and experienced, skillful workmen can make them.



Chester uses mercury columns on its hydraulic testers, for the mercury column is as accurate as a thermometer.

An image of Chester threading, magnified 200 times, is thrown on a screen by means of a powerful projector. Frequent comparison of thread samples with a standard chart assures accurate and uniform threads.



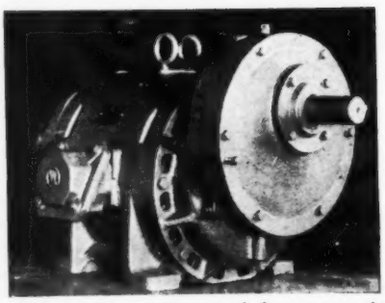
**SOUTH CHESTER TUBE CO.**
**Chester, Penna.**

# CHESTER

**STEEL CASING AND LINE PIPE**

## Explosion-Proof Gearmotors

A NEW LINE of single-reduction explosion-proof gearmotors ranging in size from 1½ to 75 hp. have been announced by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania. For application in Class 1, Group D hazardous locations where speed reduction is required, these gearmotors have many uses because of their compact design and high efficiency, the manufacturers state. Built to carry the maximum torque the motors will develop, the gears are of the single helical type, heat treated by a special "tough hard" process to provide maximum load-carrying capacity and utmost resistance to wear and shock.



Anti-friction bearings assure high efficiency and maintain correct gear center distances, it is stated.

They are inspected and approved by the National Board of Fire Underwriters for use in hazardous atmospheres containing gasoline vapors and other gases or vapors having equivalent or less hazard, such as petroleum products, ethyl alcohol, methyl alcohol, acetone, and lacquers, solvent vapors. Also, they are for use in dry-cleaning and dry-dyeing plants, pyroxylin plastic manufacturing plants, spray painting establishments, gas plants, varnish manufacturing plants, and other applications involving similar hazardous processes.


*There is only one*
**GRIZZLY . .**

— unquestionably the finest brake block ever developed for oil field service. Be sure you get the genuine by specifying the full name . . . GRIZZLY *Full-Moulded* BRAKE BLOCK.

Grizzly Blocks hold the load positively at any depth, insuring maximum safety—feed off smoother, speeding up drilling operations—and give more ton miles of service under any operating condition, insuring maximum economy.

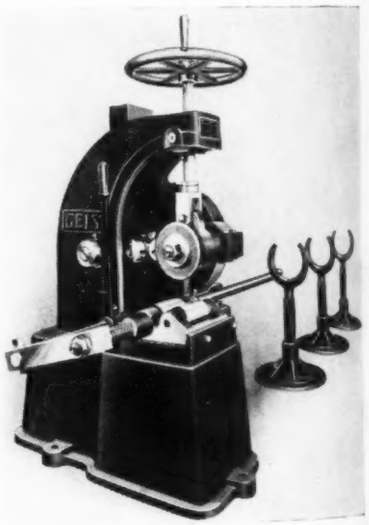
**GRIZZLY**
***FULL-MOULDED***
**BRAKE BLOCKS**

E. M. SMITH COMPANY
600-650 South Clarence Street, Los Angeles, California
Sold in the Mid-Continent and Gulf Coast By: Continental Supply Co., and T. T. Word Supply Co., Inc., Houston, Texas—In All Their Stores.
Export Office: Continental Emsco Co., 30 Rockefeller Plaza, New York City.


## Improved Geist Roller Pipe Cutter

AN improvement of interest to the trade has been made recently on the No. 4 Geist roller pipe cutter, marketed by the Landis Machine Company of Waynesboro, Pennsylvania.

The shaft carrying the disc cutter is now being mounted in Timken roller bearings instead of bronze-bushed bearings as heretofore. This makes a stronger construction, insures longer life, and eliminates the need for making frequent adjustments to compensate for wear, the manufacturers state.



The added rigidity of this mounting, as well as the precise alignment obtained between the cutter shaft and the rollers, minimize cutting-off time, reduce the burr thrown up on the pipe, and increase the life of the disc cutter.

The No. 4 Geist roller pipe cutter, as shown in the accompanying photograph, has a total capacity for cutting off pipe within a range of ¼ in. to 4 in., inclusive. All No. 4 machines now are being shipped equipped with the Timken roller bearing cutter shaft.

# 91,936 GUIBERSON TUBING CATCHERS IN USE

## *PROVES OUR SLOGAN...*

# BETTER BE SAFE THAN SORRY

**GUIBERSON Tubing Catchers have protected tubing from dropping in 91,936 wells**

**Type "B"**

For Wells Under 4000'

**FEATURES**

1. Ample Slip Area
2. Heat Treated Machined Steel Slips
3. Maximum Fluid By-Pass Area
4. Steel Head
5. Fishing Neck
6. Balanced Weight
7. Special Steel Spring
8. POSITIVE CATCH

Since 1912 when GUIBERSON pioneered the Automatic Tubing Catcher, The Guiberson Corporation has continually improved this vital tool until today they offer the operator two types of perfect Tubing Catchers, each of which will meet the requirements of any well at any depth.

By extensive laboratory and field tests with both our own and oil company engineers and production men, it was found that the slip area of the present "B" Tubing Catcher did not nor could not distort casing in wells up to 4000 feet. The new "E" Catcher was found to have more than ample slip area for wells of any depth without distorting casing.

Slips several feet long could be made on GUIBERSON Catchers. More than ample slip area is superfluous when long experience, competent engineers, the finest of materials and precision manufacture have proven to the operators that they can buy GUIBERSON Catchers with the CORRECT slip area.

Anchor your tubing. GUIBERSON Lateral Tubing Catchers have been tested and proven to: 1. Anchor tubing securely. 2. Eliminate crooked tubing. 3. Eliminate polish-rod wear. 4. Create smoother pumping action. 5. Assist in producing more oil. 6. Eliminate breathing of tubing.

See your supply house for further information.

**Type "E"**

With Anchor For Wells Over 4000'

**FEATURES**

1. Large and Ample Slip Area
2. Steel Throughout
3. Heat Treated Machined Steel Slips
4. Maximum Fluid By-Pass Area
5. Fishing Neck
6. Balanced Weight
7. Special Steel Spring
8. POSITIVE CATCH

**THE GUIBERSON CORPORATION**

Box 1106, Dallas, Texas

TULSA: 502 Wright Bldg.; HOUSTON: 2241 Herman Drive; WICHITA, KANSAS: 530 S. Fountain St.; NEWARK, OHIO: First & Locust Sts.; LOS ANGELES, CALIF: W. R. Guiberson Co., 723 E. Gage Ave.; NEW YORK: 30 Rockefeller Plaza.

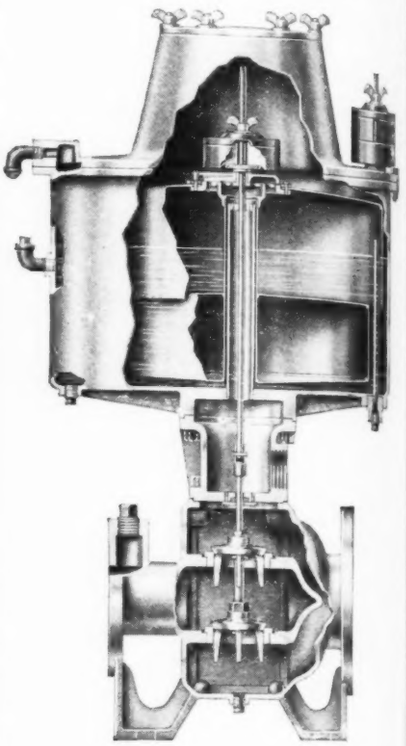
**GUIBERSON**

BETTER BE SAFE THAN SORRY

## S. & J. Supersensitive Vapor-Recovery Regulator

SHAND & JURS COMPANY, Berkeley, California, is announcing its new Supersensitive Vapor Recovery Regulator. The regulator, shown in the accompanying illustration, was designed for use in connection with vapor recovery and fire prevention systems. The individual unit can be used to control either the pressure or vacuum conditions simply by turning the disc valve shown in the top of the inverted regulator pan to either setting. It is designed to permit the removal or admission of gases, from one or a series of tanks at a very low and positive pressure. In case it is desired not to repressure, a single regulator to control outflow only is used. It operates with hairspring sensitivity within a range of from less than 1/10 in. up to 2 in. of water on either pressure or vacuum. The weight of all moving parts is counterbalanced by a liquid submerged float with an effective lifting area of 200 sq. inches. Every ounce added or taken from the counterbalanced weight changes the operating pressure 1/200 of an ounce.

The regulator requires no limits between which it will operate, since the action is positive at exactly the pressure at which it is set, the manufacturers state. It requires no adjustment during operation, the setting being made by placing weights on the top of the float assembly. Dependent only upon the capacity of the valve to handle the volume of vapor, one regulator set-up may be used for a battery of tanks. In such instances, care should be taken that the control lines to the regulator are above any liquid overflow lines. By connecting the control pipe to the flow line of the tank, this unit adapts itself to numerous applications for control of vapors in or out of scrubbers or any installation where sensitive control of vapor pressures is desired. Valves and seats are regularly of bronze but can be supplied in 18-8 stainless steel or other materials to meet special operating conditions if required. While this regulator is supersensitive in its operation, the construction is rugged throughout. It will maintain its operating efficiency under the most severe conditions without chatter, the makers state. The equipment is supplied in 2-in., 3-in., 4-in., 6-in., and 8-in. sizes.



A descriptive bulletin will be sent free upon request.


# *Honored by Oil Men*

**From the field laborer who uses this bank for his deposits and personal loans, up the line in the oil industry to the head men who decide the policies of their companies, the NATIONAL BANK OF TULSA is honored as their choice by oil men.**

***What a gamut of needs, yet the officers understand the problems of each!***

**They know every case must be studied from an individual angle, because modern banking practices have no place for guess work. Then with actual data in hand, they co-ordinate the needs of the industry or the individual with the principles of making good loans, and the result is an intelligent service to the oil industry that has earned the title, THE OIL BANK OF AMERICA.**

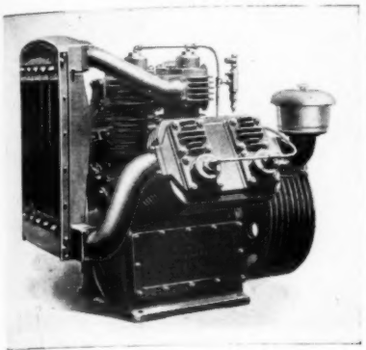
NATIONAL BANK OF TULSA

Member Federal Deposit Insurance Corporation

## Vertical-Angle 3- and 6-Cylinder Air-Cooled Compressors by Worthington

A LATE development in 3- and 6-cylinder, vertical-angle, two-stage compressors is offered by Worthington Pump and Machinery Corporation, Harrison, New Jersey.

A line of compact, self-contained units with capacities ranging from 142 to 445 cu. ft. per min. has been developed. The 3-cylinder unit has two



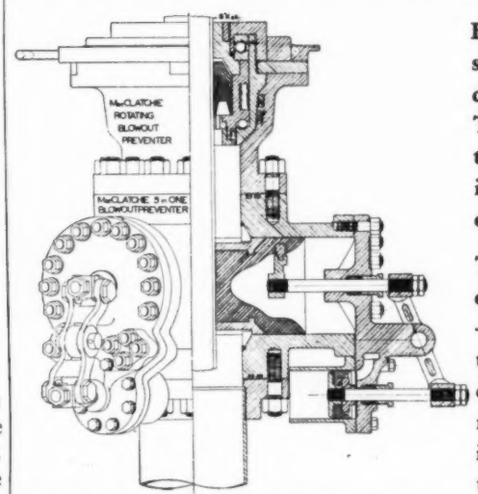
low-pressure cylinders set opposite each other at an angle, with a high-pressure cylinder set vertically between them. The 6-cylinder unit is set up in the same manner, with two cylinders side by side in each position. The units may be had with Worthington Multi-V-Drive, direct-connected to the motor through a flexible coupling, or with the motor mounted directly on the end of the crankshaft. The compactness of this unit, combined with the variety of drives available, makes it easily adapted to any installation, it is stated by the makers.

Automotive-type pistons with two compression rings, two oil rings, and full-floating wrist pins are used on all models. Articulated connecting rods permit the use of a large crank pin bearing and the same center line for all cylinders. A finned, radiator-type intercooler, with a fan that draws air through the cooler and over the cylinder head, quickly removes the heat of compression. A large oil reservoir in the crankcase, force-feed lubrication, an oil cooler, and an oil filter assure complete and efficient lubrication of all moving parts. The suction and discharge valves are in separate compartments, allowing removal without disturbing the pipe connections. The crankcase is fitted with large cover plates, providing speedy and easy inspection of the running gear.

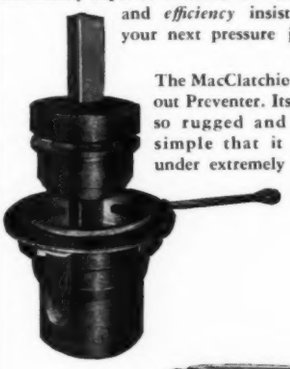
A descriptive bulletin showing photographs and details of these units may be obtained from the manufacturer. Ask for L-620-B16.


# GET THE FEATURES MOST NEEDED IN PRESSURE DRILLING WITH THE MacCLATCHIE HOOKUP

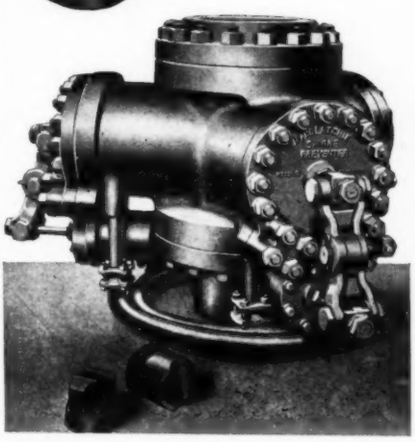
**ORERATABLE FROM DERRICK FLOOR—WITHSTANDS ANY PRESSURE ENCOUNTERED—FAST CLOSING—PACKS OFF ANY PART OF DRILL STEM WITHOUT CHANGING PACKERS—ELIMINATES EXTRA EQUIPMENT**




Both Units of the MacClatchie Pressure Hookup have many superior features. For the utmost *safety* and *efficiency* insist on them for your next pressure job.



The MacClatchie Rotating Blowout Preventer. Its construction is so rugged and its design so simple that it will stand up under extremely hard usage.



Without any change in packing, the MacClatchie "5 in 1" Blowout Preventer will pack off any part of the string such as Drill Pipe, Kelly, Drill Collar, Tool Joint or Pipe Collar.

**Both units of the MacClatchie Pressure Drilling Hookup have been designed for the safety of crews. They both operate instantly from the derrick floor thereby eliminating the hazard of men entering an oil-drenched and gas-filled cellar.**

**The "5 in 1" Blowout Preventer is operated by turning a throttle valve —completely packing off any portion of the string regardless of shape or size in 55 seconds or less. Since no sand or mud can interfere with its proper functioning it has a certainty of action. In no other equipment can be found these features: Adaptability to pack different sizes — phenomenal speed — positive operation.**

**The rotating unit is operated by pulling a rope which is run from the cellar to the derrick floor — latching or unlatching the kelly packer instantly. The packer includes a packing assembly and a swivel, with the packing assembly rotatable with the kelly and swivel providing anti-frictional bearings for the packing assembly. Designed for drilling under any mud or gas pressure.**

**The MacClatchie "5 in 1" Blowout Preventer can be rented or purchased outright. The Rotating unit is rented only.**

**MacCLATCHIE**
**MANUFACTURING COMPANY**
COMPTON, CALIF. HOUSTON, TEX.
*Mid-Continent Rental*—Monarch Mfg. Co., Oklahoma City
*Export*—Geo. R. Wood, 17 Battery Place, New York City, New York

## G-E Transformer Speed Regulators for Capacitor Motors

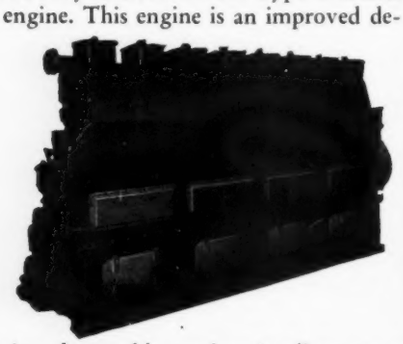
A NEW line of manually operated transformer speed regulators for high- and low-torque capacitor motors, with and without full-voltage starting for single-phase and polyphase fan motors, has been introduced by the General Electric Company, Schenectady, New York. The units consist of a tapped autotransformer and a snap switch, and, for providing full-voltage starting, a relay that affords automatic transfer to the desired running position. With special additions, the regulators are available for reversing service as well as for operation from external sources.

The snap switch provides for three speed positions, and other low speeds may be obtained from the autotransformer through reconnection of the transformer taps to the snap switch, giving a total of seven reduced speeds.

The regulators are for single-phase motors, rated up to two hp., and for polyphase motors rated up to five horsepower. The polyphase regulator combines two autotransformers connected in open delta, with a rotating snap switch mounted on a sleeve between the transformer cores. For reversing service, either polyphase or single-phase, an additional snap switch is mounted adjacent to the line switch.

## Ingersoll-Rand Type S Diesel

INGERSOLL-RAND COMPANY, 11 Broadway, New York, N. Y., recently announced its Type S Diesel engine. This engine is an improved design thoroughly modern in all respects, the makers state. It is of the vertical, 4-cycle, single-acting, solid-injection type designed to run at medium speeds and built for heavy-duty, continuous service.



The fundamental design is similar to that of the Ingersoll-Rand locomotive engine of which there are more than 140 in operation. Some of these have been in service for more than 12 years.

Type S engines are made with three, four, five, six, and eight cylinders for ratings from 150 to 460 horsepower.

A new 24-page bulletin describing these engines has been issued. It may be obtained from any Ingersoll-Rand branch office.

## Fire-Resistant Finish for Canvas Duck

ANOTHER important industrial problem has been solved with the perfection of a new fire-resistant cotton duck that, even when exposed directly to fire, will not ignite, according to the manufacturers, William E. Hooper & Sons Company, Philadelphia and Baltimore.

"Fire Chief," as both the treated fabric and the finish itself are known, has fire-resisting properties that are said to be impervious to the action of water or the elements. In addition, the new finish waterproofs the fabric, makes it mildew-resistant, and adds materially to its life, it is stated.

"Fire Chief" is available either as a finished fabric under any of the familiar Hooperwood brands of cotton duck, or as a separate finish known as "Hooperwood Fire Chief Compound."

## American Meter Company's Metric Metal Works

New air view of American Meter Company's Metric Metal Works plant at Erie, Pennsylvania. This unit of American Meter Company occupies more than 170,500 sq. ft. and employs over 300 people. In the right foreground is the new brass and alloy foundry.

## P. W. Ensign Makes Trip East

P. W. Ensign, president and chief engineer of the Ensign Carburetor Company, Huntington Park, California, left recently for Chicago to visit the company's branch at that point. It is his intention to spend about a month working with the Chicago personnel and the company's eastern factory customers.

Ensign's return itinerary includes an extended trip through the Mid-Continent, Texas, and Gulf Coast districts.

## R. L. Engstrom Chief Engineer Hydril Company

Bert L. Stone, vice-president and general manager, announces the appointment of R. L. (Jack) Engstrom to the position of chief engineer of the Hydril Company.

Engstrom has been with the company for more than nine years in the capacity of assistant chief engineer. He has been closely associated with Fred Stone, chairman of the company, and Bert Stone in the development of many of the Hydril products. His headquarters will be in the Torrance factory of the company.

R. L. (JACK) ENGSTROM


OIL LOANS

1st NATIONAL

This bank at the present time is lending over twelve and a half million dollars to the oil industry — over one-fourth of its total loans.

What better evidence that we understand the oil man's problems and requirements? What better proof that we speak the oil man's language?

More and more operators — large and small — are turning to the Southwest's Leading Bank — where they know that their needs will be sympathetically and understandingly considered — generously met.

FIRST NATIONAL BANK
IN DALLAS MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

# Field Reports are the ultimate test of Pumps & Sucker Rods

•

# INVESTIGATE AXELSON'S RECORD

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

**AXELSON MANUFACTURING CO.**

**P. O. Box 710 Vernon Station, Los Angeles**

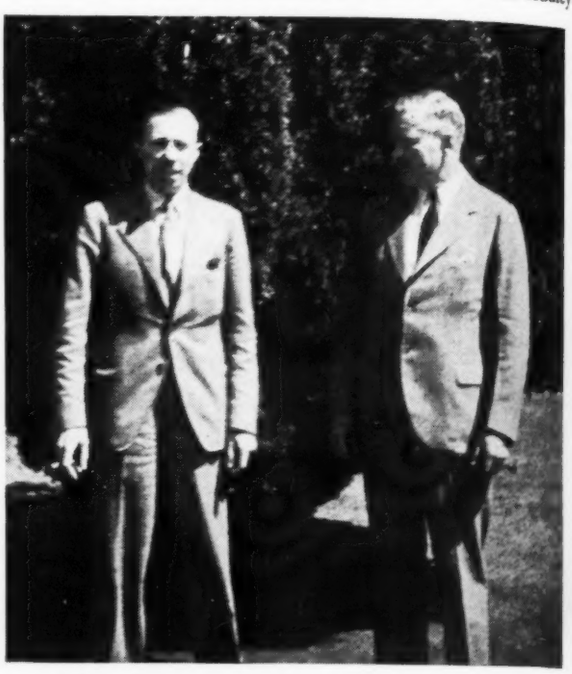
**St. Louis 50 Church Street, New York Tulsa**

*Mid-Continent and Eastern Distributor:* **Frick-Reid Supply Corp.**

*Rocky Mountain Distributor:* **Great Northern Tool & Supply Co.**


## European Officials Visit United States

For the purpose of gaining first-hand information regarding latest developments in American operations, particularly in the gas and petroleum fields, several European officials representing the products of the Merco Nordstrom Valve Company and Pittsburgh Equitable Meter Company have visited the United States. Anthony Bruyaux of Brussels, Belgium, recently arrived from Europe, accompanied by Kenneth M. Leach, son of the managing director of the Audley



ANTHONY BRUYAUX (Left) and COL. W. F. ROCKWELL

Engineering Company, Ltd., of Newport, Shropshire, England, and F. Appleyard, research and development engineer for the same company.

Bruyaux is the European representative for the two American companies. Returning to the Continent, he expects to be joined by Colonel W. F. Rockwell, president of the American concerns, who will fly there on the Hindenburg this fall. Bruyaux accompanied Colonel Rockwell to the recent convention of the Pacific Gas Association in San Francisco.

Colonel Rockwell visited Los Angeles in the interest of his companies at the conclusion of the convention, making arrangements for expansion of production and distribution facilities for valves and meters. He stated that plants for the manufacture of Nordstrom Valves have been opened in England, France, and Germany to supplement the production of the Oakland and Pittsburgh factories.

## Dearborn Chemical Extends Plant

The Dearborn Chemical Company is completing an extension to its main manufacturing plant in the Central Manufacturing District, Chicago. This is the third major addition in a dozen years and gives a 16 percent increase in floor space, which will be utilized for the installation of new equipment needed to take care of the growing volume of business in several departments, and for a modern machine shop.

The Dearborn Laboratories also were remodeled, and new equipment installed.

The factory offices were remodeled and air conditioned, and the most modern facilities installed for the convenience of employees.

# New General Offices for Lane-Wells Company

NEW buildings have been completed in Los Angeles to house the general offices of the Lane-Wells Company and its development division, Technicraft Engineering Corporation. They are at 5610 South Soto Street, in Los Angeles' newer industrial district.

The buildings are of the latest architectural design and are appointed with modern equipment throughout. Recreational facilities are provided for employees, and a portion of the grounds has been given as a playground for underprivileged children and as a cabin site for Boy Scouts.

A house warming is to be held October 17 to 24, known as "Welcome Week."

ONE MAN = 6

. . . when he goes after frozen fittings with the RIDGID Compound Leverage Wrench

No tool in your shop or kit will pay for itself more quickly than a RIDGID Compound Leverage Pipe Wrench. For it enables one lone man to turn easily pipe or fittings that often require several men and pipe on a wrench handle to start—and it lets you salvage fittings that otherwise have to be smashed off. Easy to use—put the trunnion on pipe, jaw on fitting (or vice versa) and pump it on or off. Four sizes, S2, S4, S6 and S8 for pipe up to 8". Short handles. See it at your Supply Store.

THE RIDGE TOOL CO.
ELYRIA, OHIO

RIDGID PIPE TOOLS

FIRST COST IS *last* COST

You will never hear Pomona Pump owners say, "It's not the first cost, it's the upkeep." Pomona Pumps are engineered and built for a lifetime service. When installation and operating cost are amortized over their many years of trouble-free operation, cost per day becomes unbelievably low. You won't find this inexpensive daily overhead with cheap, poorly engineered pumps. Why? Because with the purchase of such a pump, maintenance expense begins. With a Pomona, the first cost is the last cost. But don't take our word for it or even that of a Pomona salesman. Ask any of the Pomona users in your neigborhood what pump they'd buy if they had to do it over again — then you will want to get in touch with a Pomona representative. Send today for your copy of a brand-new bulletin featuring things you should know about hydraulic laboratory tests.

POMONA PUMP CO.
53 W. Jackson Blvd., Chicago • 206 E. Commercial St., Pomona, Cal.
POMONA TURBINE PUMPS

# DIESELS
## *losing power ?*

DON'T let rust, scale and dirt clog up the water jackets of your Diesels. If you do, engine cooling will suffer, you'll lose power, lubricating costs will rise.

The thing to do, particularly in this hot weather, is to clean cooling systems thoroughly, keeping them at top efficiency with inexpensive, speedy Oakite cleaning.

You'll be surprised at the greater power you'll get. Ask for details. Write today.

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OAKITE PRODUCTS, INC., 48 Thames St., NEW YORK, N. Y.
*Branch Offices and Representatives in All Principal Cities of the U.S.*

# OAKITE
TRADE MARK REG. U.S. PAT. OFF.
SPECIALIZED INDUSTRIAL CLEANING MATERIALS & METHODS

## Pumps *5 to 13 Per Cent* More Fluid

For greater pumping efficiency and longer life, especially under bad sand conditions, specify our *New Working Valve*, shown at the right, the

## B-M-W Tex Type

Ask your supply store for descriptive data, or, use the coupon below for information on any B-M-W product.

BRADFORD MOTOR WORKS, Inc., Bradford, Pa.
Please send complete information on the following B-M-W Products without obligating us in any way:
☐ TEX TYPE Plunger Fittings and Valves.
☐ BALLS and SEATS. (Made for every pumping service).
☐ ADMORE Liner Barrels.
☐ COLLINS Belt Clamps.
☐ ADMORE Insert Pump Anchors.
☐ NEILSON Tools. (Safety Sucker Rod Hooks; Tubing Hooks; Sucker Rod Elevators; Sucker Rod Sockets, etc.)
☐ Please send representative.

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*City* ..... *State* .....

BRADFORD MOTOR WORKS INC.
OIL WELL SUPPLIES
BRADFORD, PA. — TULSA, OKLA.
EXPORT OFFICE, 50 CHURCH ST., NEW YORK CITY


## Tentative A.P.I. Program

A comprehensive program, ranging from discussion of highly technical phases of petroleum and refining to trends in business and economics, is being developed by the American Petroleum Institute for its 17th annual meeting scheduled for November 9 to 12 in the Stevens Hotel at Chicago.

The preliminary program indicates that while the usual plan is being followed, a wider variety of subjects will be considered. Several speakers have not as yet been finally selected.

An attendance of close to 3000 oil men is expected at this annual "oil men's forum" of the industry. More than 100 offices, including that of Institute president and 45 memberships on the Board of Directors, are to be filled by election. The preliminary program follows:

MONDAY, NOVEMBER 9

MORNING—9:30 a. m.

Committee Meetings.

AFTERNOON—2:30 p. m.
(Private Dining, Room No. 1)

Meeting of Directors. Committee Meetings.

TUESDAY, NOVEMBER 10

MORNING—9:30 a. m.
(North Ballroom)

Meeting of Board of Councillors.
Nomination of candidates for election as members of the Board of Directors.

12:00 NOON
(Private Dining Room No. 1)

Board of Directors (luncheon).

AFTERNOON—2:30 p. m.
(Grand Ballroom)

*General Session*

Presentation of accident-prevention certificate awards. Report of Board of Councillors and election of directors.
Address, President Axtell J. Byles.
Address, Speaker to be announced.

GROUP SESSION—8:00 p. m.

*Division of Production*
(South Ballroom)

General Subject, "Materials."
Presiding, C. W. Froome, Union Oil Company of California.
Papers on the following subjects: "Use of Vanadium Steels in Production Equipment;" "Use of Molybdenum Steels in Production Equipment;" and "The Relation of Mechanical Testing to Steel Performance."

WEDNESDAY, NOVEMBER 11

9:30 a. m.
(Private Dining Room No. 1)

Board of Directors.
(The Executive Committee will meet immediately following the final session of the Board of Directors.)

GROUP SESSION—10:00 a. m.

*Division of Production*
(South Ballroom)

General Subject, "Fundamental Research."
Presiding: G. V. D. Marx, Standard Oil Co. of California.
Papers on the following subjects: "Formation Volumes and Energy Characteristics of Gas-Gap Material from Kettleman Hills Field;" "Relationship Between Organic Material in the Sediments and the Presence or Absence of Oil;" and "Present Status of Hypothesis of Biogenesis of Petroleum."

10:00 a. m.

*Division of Refining*
(North Ballroom)

General Subject: "Refining."
"Cracking and its Economic Significance," by Gustav Egloff, Universal Oil Products Co.; "The Problem of the Rational Utilization of Crude Oil and its Distillates," by V. N. Ipatieff, Universal Oil Products Co.; "The Stability of Residual Fuels," by A. H. Batchelder, Standard Oil Co. of California.

GENERAL SESSION—2:30 p. m.
(Grand Ballroom)

General Session. Program and speakers to be announced.

7:30 p. m.
(Grand Ballroom)

Annual Dinner. A program of entertainment is being arranged.

THURSDAY, NOVEMBER 12

GROUP SESSION—10:00 A. M.

*Division of Production*

(South Ballroom)

General Subject: "Drilling Practice."

Presiding: J. T. Hayward, Barnsdall Oil Company.

Papers on the following subjects: "Theoretical Determination of Collapse Strength of Casing;" "Testing Structural Silicon-Steel Members for Derricks;" and "Bottom-Hole Sampling and Analysis Apparatus."

Report of Division's nominating committee, M. E. Brock, Gulf Oil Corporation, chairman.

Election of twenty members of the General Committee of the Division of Production.

GROUP SESSION—10:00 a. m.

*Division of Refining*

(North Ballroom)

Automotive Topics:

"Lubrication Requirements of Automotive Gears and Rear Axles," by H. R. Wolf, General Motors Corporation. (Discussion).

"The Newer Bearing Materials and their Lubrication," by H. C. Mougey, General Motors Corporation. (Discussion).

Report of Division's Nominating Committee, Arthur E. Pew, Jr., Sun Oil Company, chairman.

Election of twenty members of the General Committee of the Division of Refining.

GROUP SESSION—2:00 p. m.

*Division of Production*

(South Ballroom)

General Subject: "Production Practice."

Presiding: T. V. Moore, Humble Oil and Refining Company.

Papers on the following subjects: "Flow Tests on West Texas Wells;" "Simultaneous Application of Surface and Sub-surface Dynamometers;" "Determination of Porosity and Saturation;" and "Technique for Procuring and Handling Cores for Saturation Tests."

(Following this group session, the Central Committee on Drilling and Production Practice will meet in this same room.)

GROUP SESSION—2:00 p. m.

*Division of Refining*

(North Ballroom)

General Subject: "Refining."

"Fifteen Years of Co-operative Fuel Research," by T. G. Delbridge, The Atlantic Refining Co.; "The Chemical Constituents of Lubricating Oil—A.P.I. Research Project 6," by F. D. Rossini, National Bureau of Standards; "Corrosion of Refinery Equipment," speaker to be announced.

## Linde Opens New Office

The Linde Air Products Company, unit of Union Carbide and Carbon Corporation, announces the opening of a new district office at 2 Virginia Street, Charleston, W. Va., effective October 5th with A. R. O'Neal district manager.

The new office has been added to take care of the rapid growth of business in the West Virginia area, and brings the total of Linde sales offices serving the oxy-acetylene welding and cutting needs of industry throughout the country to 31. At this new office will be maintained complete stocks of oxy-acetylene welding and cutting equipment and supplies, as well as a repair station.

## Interesting Booklet on Crude Oil Treating

The Tret-O-Lite Company, with general offices at Webster Groves, (St. Louis County) Missouri, has issued an extremely interesting booklet on the treating of crude oil. Primarily the publication is for the purpose of describing the Tret-O-Lite method of treating. Photographs and drawings show the various types of plants used in treating, which are accompanied by detailed directions of the process. Early-day crude-treating facilities and methods also are shown in pictures.

The booklet is profusely illustrated with photographs, including interesting early-day oilfield scenes, foreign oil fields, interior and exterior views of the manufacturing plant, laboratories, and offices of Tret-O-Lite at Webster Groves and Los Angeles, typical treating installations, etc.

Copies of the publication may be had by writing the Tret-O-Lite Company, either at St. Louis, Los Angeles, or Dallas, Texas.


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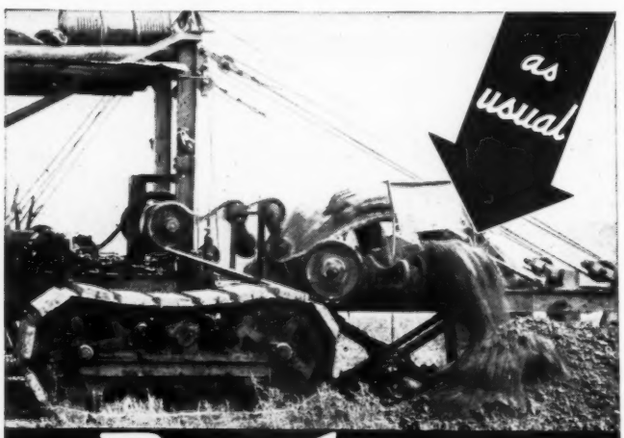


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## Chas. Chapman Transferred by Taubman

CHAS. CHAPMAN

The Taubman Supply Corporation announces the appointment of Charles Chapman as district manager of the State of Kansas and northwestern Oklahoma, with headquarters in the Union National Bank Building, Wichita, Kansas.

During the last 14 years Chapman has had a wide experience in the handling and sale of oil country materials. He was for three years at Tampico, Mexico, with the Mexican Gulf Oil Company in the supply division. When he returned to the United States, he was employed by the National Supply Company, representing them in North Texas for seven years.

After two years' experience in drilling operations in the Texas Panhandle, he was employed by the Taubman Supply Corporation and later was made manager of the Texas Panhandle district. He held this position until his recent transfer to Wichita.

## Pressure Drilling Company New Concern

The Pressure Drilling Company has recently opened offices in the Second National Bank Building, Houston, Texas.

They are distributors of a complete line of pressure drilling equipment and offer an engineering service in problems relating to pressure control.

The two partners in the firm, James C. Fortune and W. Ratliff Walne, have had a wide and varied experience in this class of work.

The Pressure Drilling Company has made arrangements with the Reed Roller Bit Company to manufacture the equipment formerly manufactured by the Emsco Derrick and Equipment Company under Fortune patents. Other equipment designed and developed by Fortune and Walne is being added to complete a full line covering all phases of pressure control.

## Alex Feild with Rector Well Equipment Co.

Alex Feild has joined the sales staff of the Rector Well Equipment Company, Fort Worth, Texas, as division representative covering north Louisiana, Arkansas, and East Texas. He will make his headquarters in Shreveport, Louisiana. Feild has been prominent in affairs of the petroleum industry for a number of years, having been connected with various major oil companies.

A. J. (Al) Powers, who has been stationed at Shreveport, has been transferred to Southwest Texas with headquarters at Corpus Christi.

ALEX FEILD

## Ideco Opens New Warehouse at Corpus Christi

The International Derrick and Equipment Company recently opened its new warehouse at Corpus Christi, Texas, with C. J. Colby in charge. The full line of Ideco and Ideco-Boykin products is now conveniently available to all South Texas fields. Jack Colby, the South Texas district manager, is well known to the trade in Texas, having formerly been in East Texas.

# Book Reviews

*Principles of Motor Fuel Preparation and Application.* By Alfred W. Nash and Donald A. Howes. John Wiley & Sons, Inc., New York. Vols. I and II. Price: $8.00 net per volume.

The authors, Alfred W. Nash, professor of petroleum technology, University of Birmingham, England, and vice-president of the Institution of Petroleum Technologists, and Donald A. Howes, of the Anglo-Persian Oil Company, Ltd., present a work on the subject of motor fuels that contains a thorough description of present day technique, and, in addition, discuss problems likely to arise in the future.

Volume I deals with the production of motor fuels by the methods of distillation, cracking, extraction from natural gas, and hydrogenation. Included also are chapters concerning the production of benzole, various synthetic fuels, including alcohols, and general storage and distribution. Volume II is concerned with the properties of motor fuels and covers such subjects as analysis, sulphur contents, gumming properties, volatility requirements, and knock ratings, as well as motor fuel and aviation spirit specifications and a chapter on automotive Diesel engines and Diesel fuels.

* * *

*Oil and Petroleum Year Book (1936).* Published by Walter E. Skinner, 15, Dowgate Hill, Cannon Street, London, E. C. 4. Price: Domestic, 10s net; foreign, 11s.

The 1936 issue of the Oil and Petroleum Year Book, compiled by Walter E. Skinner, has been issued.

The book covers 464 pages and gives complete and up-to-date particulars concerning 680 companies engaged in producing, transporting, and marketing oil, financing oil development, or directly associated in any way with the oil industry in all parts of the world.

Lists also are given of the officials connected with the companies and comprise 2,500 directors, 334 secretaries, and 211 consulting engineers, managers, agents, etc., their names and addresses and company connections.

The particulars of each company include the directors and other officials, date established, location of property or description of business, purchase consideration, oil production, capacity of refineries, capital, dividends, and financial position as disclosed by latest accounts.

Other useful features of the book are the statistical tables showing the world's production of crude petroleum for the nine years ended December, 1935, the monthly production for thirteen months ended April 30, 1936, names of the principal British oil companies, list of 634 trade names of petroleum products marketed by the various companies, and a glossary of 136 technical terms.

* * *

*Acidizing Hand Book.* By Benson M. Kingston. Published by Gulf Publishing Company, Houston, Texas. 78 pages. Price: $1.50, postage prepaid.

This volume is a treatise on the application of acid to oil wells. Complete information is given on the formations that are treatable. How to determine the treatability of formations, and the method of preparing a well for acidizing, also are fully discussed. For those planning to acidize a well, the book contains a section of tables that is extremely valuable.

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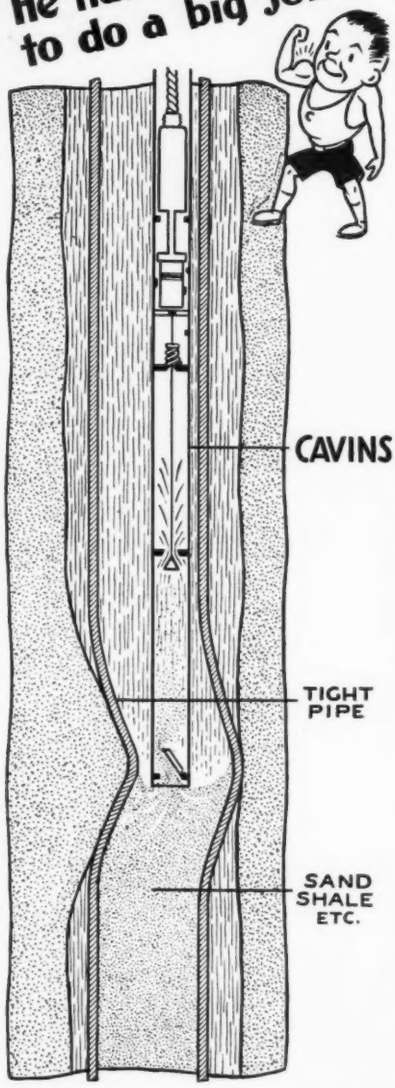


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